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Sport Fishery Abstracts

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Sport Fishery Abstracts is intended to furnish fishery biologists in government agencies and educational institutions with abstracts of the current literature in sport fishery research and management. Abstracts of papers on limnology, ecology, natural history and other fields of specialization will be included when the subject has application to the conservation of sport fish and the restoration of sport fishing.

One volume consisting of not more than four numbers will be issued each year. Each number contains separate Author and Subject indexes, with the final number of each volume containing cumulative indexes.

The last number of each volume contains a list of publications screened for appropriate material. Suggestions for improving the usefulness and coverage of Sport Fishery Abstracts are solicited.

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Prepared in the Branch of Federal Aid
Raymond E. Johnson, Chief
William R. Beckmann, Editor
Geneva T. Thompson, Asst. Editor

2121. Cromwell, Townsend, 1958. THERMOCLINE TOPOGRAPHY, HORIZONTAL CURRENTS AND "RIDGING" IN THE EASTERN TROPICAL PACIFIC. Inter-American Tropical Tuna Commission Bulletin, Vol. III, No. 3, pp. 135-164.

Explanation of two simple observable facts; the thermocline is very close to the sea surface in a region off Costa Rica and this region is biologically productive, served as the main object of this study. Seasonal charts to show thermocline depth over the entire Eastern Tropical Pacific, surface current, and phosphate content are presented.

A complete physical explanation of this Costa Rican Thermal Dome is not apparent. There is reason to believe, however, that the depth of the thermocline generally, and hence of the dome, is related to stress of the trade winds and cyclonic current shear across the dome. This does not explain why the thermocline is at any particular depth. Vertical stirring and mixing induced at the ocean surface may account for the relatively rich surface waters in the immediate vicinity of the dome.

2122. Schaefer, Milner B., Yvonne M. M. Bishop, and Gerald V. Howard. 1958. SOME ASPECTS OF UPWELLING IN THE GULF OF PANAMA. Inter-American Tropical Tuna Commission Bulletin, Vol. III, No. 2, pp. 79-132.

Various physical, chemical, and biological phenomena associated with the importance of seasonal upwelling to the ecology of the Gulf of Panama were studied. Significant correlations among year-to-year spring values of Balboa northerly winds, sea temperature, and sea level were found. In addition, for each of the variables, long-term trends which are related to each other were found. Analysis of the observed correlation of trends showed that the local year-to-year anomalies of wind are an important element in determining the year-to-year anomalies in sea temperature and sea level, even after the long-term trends have been subtracted.

2123. Hubbs, Clark, and George E. Drewry. 1958. LONG DURATION OF SPERM FUNCTION IN TWO EURYHALINE FISHES AND ITS LACK OF SIGNIFICANCE IN HYBRIDIZATION. The American Naturalist, Vol. XCII, No. 867, pp. 378-380.

The phenomenon of a much greater incidence of hybrids among fresh water than marine fishes could be explained by an isolating mechanism such as duration of sperm function. Tests of the hypothesis using heterospecific matings of euryhaline teleosts showed that sperm of these fish retained its fertilizing powers much longer than tested fresh-water fishes. Some other isolating mechanism must therefore be at work, perhaps hybrid viability.

2124. Nicholls, A. G. 1958. THE EGG YIELD FROM BROWN AND RAINBOW TROUT IN TASMANIA. Australian Journal of Marine and Freshwater Research, Vol. 9, No. 4, pp. 526-536.

Counts of eggs stripped from brown and rainbow trout show that over a sufficiently large size range the relationship to fish length is curvilinear. A direct relationship exists between egg numbers and fish weights. Brown trout from the Great Lake do not yield the expected number at larger sizes. The yield from rainbow trout is higher than that from brown. (Auth. summ.)

2125. Bogitsh, Burton J. 1958. OBSERVATIONS ON THE SEASONAL OCCURRENCE OF A PSEUDOPHYLLIDEAN TAPEWORM INFECTING THE ALIMENTARY TRACT OF LEPOMIS MACROCHIRUS MACROCHIRUS RAF. IN ALBEMARLE COUNTY, VIRGINIA. The American Midland Naturalist, Vol. 60, No. 1, pp. 97-99.

From this study, it must be concluded that the tapeworm, Bothriocephalus sp., cannot achieve sexual maturity in the alimentary tract of Lepomis m. macrochirus. The fish, therefore, either serves as an intermediate host or is accidentally parasitized.

Percentage infection by months indicates that: (1) the plerocercoid forms attain their maximum development in the spring, probably in May or early June; (2) the parasite is eliminated from the fish host in the middle of June, thus culminating a gradual decrease in the incidence of infection from the peak observed during the winter months; (3) the parasite is introduced into the fish host in late June or early July. Further life cycle and host specificity studies are now in progress.

2126. Motwani, M. P., and A. Davis. 1957. FISHES OF THE RIVER SONE WITH OBSERVATIONS ON THE ZOOGEOGRAPHICAL SIGNIFICANCE. Journal of the Zoological Society of India, Vol. 9, No. 1, pp. 9-15.

A total of 95 species representing 20 families are recorded. All but 12 species were collected during survey work in 1952-53. The zoological significance of the fish fauna is discussed.

2127. Tavolga, William N. 1958. UNDERWATER SOUNDS PRODUCED BY MALES OF THE BLENNIID FISH, CHASMODES BOSQUIANUS. Ecology, Vol. 39, No. 4, pp. 759-760.

The males of the blenniid fish, Chasmodes bosquianus, produce low-pitched grunting sounds during courtship. Component frequencies range from below 100 to 450 cps with occasional peaks up to 600 cps. The sounds are non-harmonic, with most of the energy in the 80 to 180 cps. The amplitude is highest at the beginning of the sound. The average duration of each sound field is 155 milliseconds. The intensity of the sound field at a distance of 8" to 12" from the hydrophone is estimated at 0.5 to 0.8 microbar. Repetition of the sounds is variable but is usually every one or two seconds.

The emission of the sound is synchronized with a quick sidewise shake of the head. The mechanism of sound production is unknown. (Auth. summ.)

2128. Barlow, George W. 1958. DAILY MOVEMENTS OF DESERT PUPFISH, CYPRINODON MACULARIUS, IN SHORE POOLS OF THE SALTON SEA, CALIFORNIA. Ecology, Vol. 39, No. 4,

pp. 580-587.

Shallow pools are a regular feature of the shore line of the Salton Sea. The desert pupfish is abundant in these pools. The temperature of the water of the shore pools changes rapidly. The shallow water heats and cools faster than the deep water. For a short period during each morning and each evening the pools are rather uniform in temperature.

The pupfish spends the nights in the shallowest, coolest areas of the pools. At dawn it moves into the warmest, deepest areas. Later in the morning, during the summer, it works its way into the shallow parts of the pools. Then it retreats from the shallows when the water temperature there exceeds 36°-37°C. It returns to the shallows when the water cools to 36° - 37°C or below. During the winter the pupfish does not move into the shallows until midafternoon and it remains there into the night. (Auth. summ.)

2129. Armitage, Kenneth B. 1958. ECOLOGY OF THE RIFFLE INSECTS OF THE FIREHOLD RIVER, WYOMING. Ecology, Vol. 39, No. 4, pp. 571-580.

The Firehole River flows along a fault in a rhyolite lava plateau and through a series of centers of hydro-thermal activity. The runoff water from the hot springs flows into the river and profoundly changes its physical and chemical characteristics. This change is evident in the progressive downstream increase in temperature, pH, and alkalinity.

Nine stations for sampling bottom fauna were located along the river above and below all the major influxes of hot spring water into the river. The samples of bottom organisms were collected from July through October 1952, and in May 1953. The organisms were identified, counted, and weighed.

The Gardiner River and Lava Creek were surveyed to gather more information about the various factors influencing the ecology of the bottom fauna. The Gardiner River was sampled above and below an inflow of hydro-thermal water. Lava Creek does not receive any hot spring water.

The average yearly standing-crop of the Firehole River and other Yellowstone Park streams was positively correlated with temperature and bicarbonate alkalinity, the latter being highly significant. Analysis of data from other streams and lakes further illustrated the influence of alkalinity on standing crop of organisms.

Standing crop, as expressed by weight, was shown to be high in the spring with a gradual decrease in the summer to a low in the fall. Another factor influencing the level of standing crop is the physical composition of the stream bottom. Rubble bottom had an average of 2.48 times the weight of organisms on bedrock.

The relative-density of Trichoptera, Ephemeroptera, Coleoptera, and Diptera was plotted against average alkalinity. Trichoptera had a statistically significant positive correlation, Ephemeroptera had a significant negative correlation, and Coleoptera and Diptera had a negative but nonsignificant correlation.

It was postulated that alkalinity might be the chief factor that determines the level of standing crop in a stream, but that this level can be highly modified by the action of temperature and current and by the physical composition of the stream bottom. Since all of the above mentioned factors interact to determine the level of the standing crop of bottom fauna, it does not seem possible to establish any system of stream classification based on a hierarchy of importance of the various environmental factors except for local pragmatic use in stream management. (Auth. summ.)

2130. Shapiro, Joseph. 1958. THE CORE-FREEZER--A NEW SAMPLER FOR LAKE SEDIMENTS. Ecology, Vol. 39, No. 4, p. 758.

An instrument is described which is particularly suited to the collection of very soft sediments. It is inexpensive to build, simple to operate, and possesses certain advantages over other types of corers. Crushed solid carbon dioxide and n-butyl alcohol is used as the refrigerant.

2131. Jones, S. 1957. AUTHORSHIP OF NAMES OF INDIAN FISHES PROPOSED IN "HISTOIRE NATURELLE DES POISSONS" BY CUVIER AND VALENCIENNES AND RECORDED BY DAY. Journal of the Zoological Society of India, Vol. 9, No. 2, pp. 121-129.

According to International Code of Zoological Nomenclature, the conventional practice of crediting dual authorship to the names of fishes first proposed by Cuvier and Valenciennes in their "Histoire Naturelle des Poissons" is not considered correct since the different sections were written under their individual responsibility. Of the 22 volumes of the above work published from 1828 to 1949, Baron Cuvier had share only up to the 9th volume which was in press at the time of his death in 1832. 257 species under the dual authorship of Cuvier and Valenciennes are recorded by Day in his Fishes of India (1876-1888) and Fishes (1889) in the "Fauna of British India" Series. Of these, Cuvier is responsible for descriptions of 99 species and Valenciennes for 158 species. These are checked and listed with the appropriate author's name against each species. (Auth. summ.)

2132. Ganapati, P. N., and K. Srinivasa Rao. 1957. ON THE BIONOMICS OF SARDINELLA GIBBOSA (BLKR) OFF WALTAIR COAST. Journal of the Zoological Society of India, Vol. 9, No. 2, pp. 162-182.

Studies on the food and feeding habits of S. gibbosa show that the fish is predominantly a zooplankton feeder, and that selective feeding is exercised, involving active efforts on the part of the fish, though the fish is generally believed to be a filter feeder.

Maturity and spawning studies based on the condition of the gonads, ponderal index of the fish, and the seasonal occurrence of eggs in the plankton show that the spawning period of the fish commences in the month of February and probably extends over a prolonged period. The size at first maturity of the fish was found to be between 110mm. and 120mm. The

fish probably migrates to the off shore waters for spawning, as no mature specimens were obtained in the fishermen's catches. After spawning was over the young juveniles start returning to the inshore waters in the month of April.

The intensity of the feeding activity based on the average volume of food per stomach of the fish can be divided into three stages:-(a) active feeding which synchronizes with the period just after spawning in the months of March, April and May; (b) a low intensity of feeding which coincides with a fall in the abundance of plankton in the coastal waters, and (c) a subsequent gradual rise in the intensity of feeding till January.

The trematode parasites Aponurus sp. and Hemiurus sp., Nematode parasites and a copepod parasite belonging to the species of Caligus were found to be parasitic on S. gibbosa. (Auth. summ.)

2133. Seshadri, B. 1957. SEASONAL VARIATIONS IN THE TOTAL BIOMASS AND TOTAL ORGANIC MATTER OF THE PLANKTON IN THE MARINE ZONE OF THE VELLAR ESTUARY. Journal of the Zoological Society of India. Vol. 9, No. 2, pp. 181-191.

1. The total biomass and total organic matter in the 'settling volume of the plankton net-catches' show tidal and seasonal variations.

2. An analysis of these variations has shown that the plankton in this zone has a considerable endemic phytoplankton element at low tide. At high tide the neritic fauna is brought in by the influx of neritic waters.

3. The total biomass shows a minor peak in March and a major peak in May at high tide as well as at low tide. The organic matter shows similarly two peaks at high tide, but the low tide has only the major peak.

4. The biomass and organic matter peaks are parallel at high tide but at low tide the correspondence does not exist, in March. This is due to the disappearance at low tide of most of the pteroped swarms which come in at high tide.

5. The major peak for organic matter is slightly high at low tide. This is due to an endemic phytoplankton population in the estuary which has a greater density at low tide, but at high tide when there is the influx of sea water the 'settling volume of the photoplankton in the net-catch' is less dense.

6. The variations in the phosphate content at low tide and high tide are discussed in relation to the variations in the organic matter. (Auth. summ.)

2134. Kuthalingam, M. D. K. 1957. LIFE HISTORY AND FEEDING HABITS OF CYNOGLOSSUS LINGUA (HAM. BUCH.) Journal of the Zoological Society of India, Vol. 9, No. 2, pp. 208-215.

The eggs and the pro-larvae of Cynoglossus lingua are described.

The absorption of yolk, the change in colour, the number of pre-anal myotomes and the growth in size of these pro-larvae which become changed into post-larvae are described. The details of the food they take at every stage are given.

An account of the metamorphosis of post-larvae into juveniles is given.

The juveniles are described and their diet analysed and contrasted with those of the adults. (Auth. summ.)

2135. Hepher, B. 1958. THE EFFECT OF VARIOUS FERTILIZERS AND THE METHODS OF THEIR APPLICATION ON THE FIXATION OF PHOSPHORUS ADDED TO FISHPONDS. Bamidgeh, Vol. 10, No. 1, pp. 4-18.

Addition of carbon dioxide in a laboratory experiment had an appreciable effect on phosphorus concentration, probably due mostly to lowering of pH. Similar results can be assumed for addition of organic manure to ponds, though experimental testing is made exceedingly difficult by the many side effects of the manure, both positive and negative, on fish yield.

Fertilizer applied in solution showed no benefits; in fact application of particulate fertilizer exhibited a small advantage.

Though laboratory tests showed an accumulation of phosphorus in the water and an increase in its concentration with time with small frequent applications, pond tests showed no such effect. Also, there are maximal and minimal doses between which fixation was the least.

Fertilization with phosphoric acid and ammonium phosphate gave a higher concentration of phosphorus than superphosphate. This effect was noted both in laboratory and pond tests. Of the two, ammonium phosphate is the more promising. No clear effect on fish yield was noted however.

2136. Hepher, B. 1958. ON THE DYNAMICS OF PHOSPHORUS ADDED TO FISHPONDS IN ISRAEL. Bamidgeh, Vol. 10, No. 1, p. 3.

The fate of phosphate added to fishponds and the inorganic processes of phosphorus fixation were studied in Israel. Conditions in these ponds are different from those of the more humid climatic zones in having alkaline water and high calcium content. In these conditions most of the phosphorus added is precipitated as $Ca_3(PO_4)_2$. The quantitative theoretical aspects of this are discussed. Another factor in the phosphorus fixation is the bottom mud. This fixation in the alkaline conditions prevailing is believed to be partly due to an ion exchange reaction of the colloids and partly to reaction with calcium carbonate and not with heavy metals. The fixation of phosphorus to the mud is affected by the composition of the mud, becoming greater when the calcium carbonate and total colloids are higher. Fixation of phosphorus is lower with the accumulation of organic matter in the mud because of the low phosphorus adsorption capacity of organic colloids. Phosphorus fixation is higher when the mud is mixed with the water of the pond. In the fishpond this is done by the carp in its search for food in the bottom mud. (Auth. abst)

2137. Goss, Richard J. and Martha W. Stagg. 1957. THE REGENERATION OF FINS AND FIN RAYS

IN FUNDULUS HETEROCLITUS. The Journal of Experimental Zoology, Vol. 136, No. 3, pp. 487-507.

The regeneration of pectoral fins in Fundulus heteroclitus has been investigated with particular reference to the regeneration of bony fin rays under various experimental conditions.

Normal fin regeneration occurs by the formation of a terminal blastema from fibroblasts derived from the connective tissue subjacent to the level of amputation. Osteoblasts, formerly associated with the stumps of the old fin rays, invade the upper and lower sides of the incipient regenerate, where they soon initiate the deposition of dermal bone immediately beneath the epidermal basement membrane. Further development occurs by the terminal addition of new ray segments, concomitant with the elongation of the regenerate.

If the ventral halves of fin rays are entirely removed, amputation of the fin is followed by the production of similarly deficient regenerates. Extirpation of ventral fin ray components for several segments proximal to the level of amputation results in ray regeneration from the more proximally located ray stumps. Fin rays transplanted to interradial areas, followed by amputation of fins through the treated regions, induce the formation of supernumerary rays in the subsequently produced fin regenerate. It is concluded that fin ray regeneration normally occurs only under the influence of osteoblasts derived from pre-existing rays.

Removal of parts of fin rays from the middle, or from the proximal or distal ends of unamputated fins, is readily followed by ray regeneration in a distal direction. Replacement of rays by proximally directed growth from distal stumps is either absent or delayed, presumably because the nerve supply is interrupted by the operation.

Following the amputation of denervated fins, regressive changes in the soft tissues of the fin occur, attended by erosion of terminal ray stumps by osteoclasts. The replacement of extirpated portions of individual fin rays is also dependent upon the presence of nerve fibers. (Auth. summ.)

2138. Bailey, Robert E. 1957. THE EFFECT OF ESTRADIOL ON SERUM CALCIUM, PHOSPHORUS, AND PROTEIN OF GOLDFISH. The Journal of Experimental Zoology, Vol. 136, No. 3, pp. 455-469.

Estrogen administration, estradiol benzoate in sesame oil given intraperitoneally, resulted in an increase in the serum level of non-ultrafilterable calcium and phosphorus and in total protein. No increase in ultrafilterable calcium or phosphorus was observed. Part of the increase in non-ultrafilterable calcium is due to the appearance in the blood of colloidal calcium phosphate. This compound accounts for all of the non-ultrafilterable inorganic phosphorus The remainder of the non-ultrafilterable calcium is bound to the serum phosphoprotein, vitellin. This compound accounts for the rise in total protein and protein phosphorus. It is suggested that the vitellin is formed in the liver, released into the blood, and transported to the ovaries where it is deposited in the developing ova.

Increases in lipid phosphorus appear to be independent of the increases in the other fractions. (Auth. summ.)

2139. LeCren, E. D. 1958. OBSERVATIONS ON THE GROWTH OF PERCH (PERCA FLUVIATILIS L.) OVER TWENTY-TWO YEARS WITH SPECIAL REFERENCE TO THE EFFECTS OF TEMPERATURE AND CHANGES IN POPULATION DENSITY. The Journal of Animal Ecology, Vol. 27, No. 2, pp. 287-334.

The opercular bones of perch collected mostly in traps from 1942-1956 are analysed for age and back-calculated growth to provide data on the growth of perch in Windermere and changes occuring from 1934 to 1956. There was no sex difference in growth in the first and second year of life. Subsequently, female perch grew slightly faster than the males. Male and female perch that mature in their second and third years respectively were slightly larger at this age than those that matured later. Considerable year-to-year variations occurred in growth at all ages, and these were correlated with variations in summer water temperature measured as degree-days over 14°C. Regressions of growth on temperature accounted for up to two-thirds of the year-to-year variation in growth. The trap fishery started in 1941 reduced the dense population to about 13% of its orginial density by 1943 and thereafter at a slower rate. From 1949-55 the population remained relatively constant at about 3% of its density in 1940. Increases in growth-rate caused the biomass to fall to only about 8% of its 1940 density. Before 1941, the perch in Windermere grew slowly; the adults having an annual weight increment of about 5g. Perch adult in 1941 increased their growth sharply in 1941 after the first season of the fishery. These fish maintained a steady average increment of about 10g in subsequent years in spite of further reductions in population density. After 1941 each new year-class of perch showed increased growth-rate in its third and fourth year of life, which rate was maintained approximately constant in later years. The average annual increment in weight for adults of each year-class thus increased from about 10g for the 1938 and 1939 year-classes to 52g for the females of the 1952 year-class and 37g for the males of the 1953 year-class. This increase closely followed an exponential curve and adult growth-rate was highly correlated with time from the start of the fishery but not with changes in population density after 1941. Growth in the first two years of life remained relatively constant in spite of great fluctuations in population density of fry. Second-year growth was to some extent negatively correlated with the density of yearlings. The changes in growth-rate resulted in approximate increases in the average weight of trapped perch from 30g to 120g and angled perch from 65g to 170g. The size increase also increased the number and biomass density of fish-feeding perch and decreased still further the density of benthos-feeders. The implications of these results are discussed in relation to the literature on perch growth, the probable changes in benthos and other

fish species in Windermere and forecasts of further changes in perch growth. (Auth. summ.)

2140. Yashouv, A. 1958. BIOLOGICAL DATA ON TILAPIA GALILAEA AND TILAPIA NILOTICA IN THE FISH PONDS. Bamidgeh. Vol. 10, No. 3, pp. 47-52.

Three biological aspects, reproduction, rate of growth, and nutrition, of the mixed culture of these two species of tilapia with carp are discussed.

2141. Kitai, H. (Ma'agan Michael). 1958. MOBILE PUMP FOR INCREASING THE OXYGEN CONTENT OF THE PONDWATER. Bamidgeh. Vol. 10, No. 3, pp. 52-54.

A mobile pump consisting of a motor attached to small raft is described, and successful uses in pond-fish culture in addition to oxygenation of water are covered.

2142. Weatherley, A. H. 1958. GROWTH, PRODUCTION AND SURVIVAL OF BROWN TROUT IN A LARGE FARM DAM. Australian Journal of Marine and Freshwater Research. Volume 9, Number 2, pp. 159-166.

Two releases of yearling brown trout in a large farm dam were unsuccessful, the first because of the escape of the fish in a flood, the second for unknown reasons, though the fish which were recovered from both these releases had grown well. A third release, of 3300 yearlings, proved comparatively successful, for while the fish did not grow quite so well as in earlier years, 904 of them were recovered after 10 months. The total weight of fish in the reservoir as a result of the second and third releases represented a standing crop of 43.5 lb/acre or a production (for 10 months) of 21.8 lb/acre. It was found that trout could become sexually mature, though they lacked suitable spawning grounds (Auth. summ.)

2143. Nicholls, A. G. 1958. THE TASMANIAN TROUT FISHERY. III. THE RIVERS OF THE NORTH AND EAST. Australian Journal of Marine and Freshwater Research. Volume 9, Number 2, pp. 167-190.

The study of the daily catch from the North and South Esk River systems, as derived from angler's returns, shows a general fall which appears to be statistically significant in all rivers except the Meander. It appears to become increasingly important from west to east. It is accompanied by a fall in the annual catch per angler which is closely correlated with an increase in the number of licenses issued, from which it might appear that these streams are being fished to their full capacity. A study of the mean lengths of fish at capture does not show any decrease compatible with over-fishing, and there has been no increase in growth rate, which might be expected under conditions of overfishing. The age distribution of fish caught by anglers does not indicate any decrease in the proportions of older fish. A personal canvass of 53 anglers in one district showed a mean total catch per angler of 259 fish, whereas the figure derived from anglers' returns for the same season was 20 fish per angler. It is concluded that the apparent decline in catching rate was due to the returns from anglers being unrepresentative. No correlation was found between the catches by anglers and the fish available to them as a result of stocking these streams. (Auth. summ.)

2144. Koto, Hideto and Takeji Fujii. 1958. STRUCTURE OF THE WATERS IN THE BERING SEA AND THE ALEUTIAN REGION. Bulletin of the Faculty of Fisheries Hokkaido University. Vol. 9, No. 3, pp. 149-170.

Along the southern side of the Aleutian Islands the Alaska current, which originates in the Gulf of Alaska, flows westerly. The major part of this current flows into the Bering Sea close to the west of Attu Island and through the western channels. In the Bering Sea, waters from the Pacific take counterclockwise circulation, and then flow out along the Kamchatka Peninsula toward the southwest. Between this flow from the Bering and the easterly Subarctic Current, a counterclockwise gyral, named the Western Subarctic Gyral in this paper, occurs. On the continental shelf off Alaska, the water flows northward, however, part of it turns toward the southwest and flows along the Asiatic coast.

The waters in these regions, referring to the T-Cl curves, are classified into five groups. The distribution of them corresponds to the current systems above stated.

The water of the Alaska Current is relatively warm, and has low chlorinity in the surface layer. In the eastern portion of this current, the water has scarcely been cooled so intensively as to contain a dichothermal layer in the summer. An indistinct layer of minimum temperature is formed below the convection layer by mixing of the water of the northern Subarctic current.

Inshore the Aleutian Islands, the surface water is lower in temperature and higher in chlorinity than corresponding values of both sides in consequence of the vertical mixing when the water passes over the ridge.

On the shallow continental shelf in the Bering, the water has been severely cooled to below 0°C, and has extremely low chlorinity especially at the surface in summer. However, the surface in this region, as well as in the coastal region of Kamchatka, is more warmed than the central Bering because of the larger vertical stability in summer.

In the Bering basin, the dichothermal layer is very distinct; its temperature ranges 1° to 3°C, the depth ranges 100 to 250 meters, and in the northern portion the temperature is lowest and the depth is deepest. The dichothermal layer in this region, as well as that in the Western Subarctic Gyral, characteristically indicates the bottom of the convection layer formed in the previous winter. Near the northern continental shelf, there are encountered two minima of temperature of which the upper one is attributed to the mixing of the more cooled water on the continental shelf. The maximum temperature in the

lower layer is never found decreased to below 3.4°C even at the lowest in the northern portion.

In the Western Subarctic Gyral, the temperature of the dichothermal layer is about 2°C, and the depth is 100 meters, nevertheless the maximum temperature lying at the 300-meter level is lower than the lowest in the Bering. The lower water in this region is a mixture of the lower waters of the Bering and the Okhotsk Sea.

In the northern Subarctic Current, an indistinct layer of minimum temperature appears below the convection layer, and for all lower layers the temperature is lower than in the Alaska Current. The lower water in this region is a mixture of the lower waters of the Subarctic Current and the Western Subarctic Gyral.

In the lower layers all over the regions, the water of the Alaska Current decreases in chlorinity because of vertical mixing going on in the Bering circulation, especially in the northern portion of the Bering owing to the development of the convection in the winter. In the Western Subarctic Gyral, the water has been more diluted by mixing of the Okhotsk water, however, it shows rather higher cholorinity than the surrounding waters on account of the ascending motion taking place in the gyral. (Auth. summ.)

2145. Nikolyukin, N. I. 1958. DISTANT HYBRIDIZATION OF FISH (OTDALENNAYA GIBRIDIZATSIYA RYB). Priroda, 1958, Nr. 2, pp. 31-38. (In Russian). SOV/STEP 26-58-2-5/48.

The author deals both with interspecific and intraspecific hybridization in fish, of which the latter is the more usual form. The resulting hybrids are usually intermediary between the two parents but mostly tend to favor the characteristics of one or the other. Intraspecific hybrids are usually fertile, but the interspecific ones show a variation from almost complete fertility to complete sterility. Hybrids have two uses: as food fish without further breeding, or as a basis for selective breeding. The USSR is very interested in breeding hybrids from salt-water fish which could exist in fresh-water conditions and would be used to stock the storage-lakes, fish ponds and rivers. The question of fertility and early maturing is of importance. In 1949, the Saratovskoye otdeleniye (Saratov Department) of the VNIORKh conducted experiments to try to obtain a hybrid, combining the swift growth of fish such as the sturgeon and beluga with the freshwater properties of the sterlet. They obtained a fish which weighed 400-500 grams after two years' growth and twice that by the end of the third year. The author mentions several successful hybrids which have been produced: a triple hybrid beluga-sterlet-sevruga (Fig. 4 and 5), sterlet -beluga. When the fish are finally released into the ponds and rivers the hybrids breed either among themselves or, as is more usual due to their greater numbers, with one of the parent species, in which case they tend to assume more and more the characteristics of the species. V. I. Michurin obtained new sorts of fruits and berries by hybridization and created the theory of distant (interspecific) hybridization. N. V. Tsitsin has continued his work and has developed valuable wheat-couch-grass hybrids. Academician V. L. Komarov has pointed out the wide spread of hybridization in the plant world. N. A. Timofeyeva collaborated with the author in his hybridization experiments on fish. There are 10 photos, 1 graph, and 9 references, 4 of which are Soviet, 1 Swedish, 1 Dutch, 1 German and 2 English.

2146. Shemanskiy, Yu. A., 1958. FISHING WITH SOUND (LOV RYBY NA ZVUK), Priroda, 1958, Nr. 2, pp. 104-105. (In Russian). SOV/STEP 26-58-2-28/48.

Water is a better medium for transmitting sound than air and it has been shown that fish have a well developed sense of hearing. Fish emit different sounds during different activities and can use their hearing as a sort of radar to detect the location of food and avoid obstacles around them, much as bats do. The author lists the various types of calls made by some fish. This is a great help to fishing vessels fitted with hydrolocation devices. Several "sound" baits and lures for amateur fishing are mentioned. There is 1 Soviet reference.

2147. Sigler, William F. 1958. THE ECOLOGY AND USE OF CARP IN UTAH. Utah State University, Agricultural Experiment Station, Bulletin 405, 63 pages.

This bulletin covers carp ecology, their range, habitat requirements, selected habitats, food habits, reproduction, age and growth, movement, limiting factors, and relation to other species. Also discussed are control and use of carp, crop estimating and harvesting, and economics.

2148. Grundy, F. 1958. THE USE OF CETYL ALCOHOL IN SOLUTION TO REDUCE EVAPORATION FROM RESERVOIRS. REPORT ON AN EXPERIMENT ON MALYA RESERVOIR IN TANGANYIKA TERRITORY, IN AUGUST, 1957. Mem. E. Afr. met. Dep., Vol. 11, No. 11, 13 pp; Water Pollution Abstracts, Vol. 31, No. 10, Abst. No. 1940. 1958.

Work on the use of cetyl alchol in small reservoirs has already been reported. A controlled experiment was commenced in August 1957 on a larger reservoir in order to determine whether it was possible to maintain a film on a water surface which was subject to greater disturbance by waves, and also the amount of cetyl alcohol required under these conditions. In accordance with the recommendations made in the previous report, the reservoir selected was Malya reservoir, in Tanganyika, 60 miles south of Mwanza; it has a surface area of about 130 acres, of which about 20 acres are covered with aquatic vegetation. The hydrology of the reservoir is carefully considered. The experimental procedure was similar to that used with the smaller reservoirs, a further correction being applied to the results to allow for the surface of water covered by vegetation. The cetyl alcohol preparation used contained 45 per cent cetyl alcohol, 4 per cent stearyl alcohol, 10 per cent myristyl alcohol, and 5 per cent unsaturated alcohols; the solvent used was paraffin; and Pluronic F68, a spreading agent, was also added to the solu-

tion. Details are given of the calculation of results from measurements of fall in water level and pan evaporation with and without cetyl alcohol treatment. Attempts are made to explain the comparatively small reduction in evaporation (11 per cent) which was achieved and the large amount of cetyl alcohol consumed (0.75g per acre per day). The experiment, however, indicated that a film of cetyl alcohol can be established on a water surface disturbed by wind of an average velocity of about 15 m.p.h. sustained for periods up to 4 hours, and having a fetch of about 1000 yards.

2149. Rossi, L. A. 1957. NOTES ON METHODS OF ESTIMATION OF PLANKTON. II. SUGGESTIONS FOR THE ANALYSIS OF PLANKTON IN WATERS OF HIGH TURBIDITY. Rev. Obr. sanit. Nac., B. Aires, Vol. 39, pp. 85-90. Water Pollution Abstracts, Vol. 31, No. 11, Abst. No. 2111. 1958.

After a discussion of the factors affecting the precision of methods of estimating plankton, with references to previous publications, the determination of plankton in water of high turbidity is discussed in detail, with reference to the analysis of water from the rivers Parana, Uruguay, and la Plata, and the use of the Sedgwick-Rafter cell. In waters of high turbidity, it is impossible to increase the concentration of the sample, and the precision of the method can only be improved by examining a larger area which increases the duration of the tests. A description and diagrams are given of rectangular diaphragms, of which the height: width ratio is 1:1.66, which are placed in various positions in relation to the circular aperture of the microscope, and enable improved vision, decrease the time required, and improve the precision of the method. A bibliography of 25 references is appended.

2150. Lefèvre, M., and G. Farrugia. 1958. THE EFFECT ON FRESH-WATER ALGAE OF THE PRODUCTS OF NATURAL DECOMPOSITION OF ORGANIC SUBSTANCES OF ANIMAL AND PLANT ORIGIN. Hydrobiologia, Vol. 10, pp. 49-65; Water Pollution Abstracts, Vol. 31, No. 11, Abst. No. 2112. 1958.

Experiments are described on the effect of the products of natural decomposition of organic matter on fresh-water algae. It was found that the effect of such decomposition products is specific, and differs according to whether they are of plant or animal origin. When the decomposition product has a deleterious effect, it can induce morphological and cytological modifications in algae.

2151. Brook, A. J. and A. V. Holden. 1957 FERTILIZATION EXPERIMENTS IN SCOTTISH FRESHWATER LOCHS. I. LOCH KINARDOCHY. Scottish Home Department, Freshwater and Salmon Fisheries Research. H. M. Stationery Office, Edinburgh, 30 pp; Water Pollution Abstracts, Vol. 31, No. 11, Abst. No. 2114. 1958.

The results are given of the first of a series of experiments on the fertilization of fresh-water lochs in Scotland. In this experiment, calcium superphosphate was added to loch Kinardochy, a small hill loch in north-west Perthshire. Regular chemical analyses were made for about 18 months before, and at least 18 months after fertilization. Particular attention was paid to the removal of the added phosphate. Of the various factors which could have been responsible for the disappearance of the phosphate, it appeared that the most important were assimilation by the submerged macrophytic vegetation and assimilation by the attached algal flora. Quantitative changes in the phytoplankton of the loch following enrichment were studied for $4\frac{1}{2}$ years. In the first year after fertilization, the standing crop increased by about 8 times, in the second year it was about half this amount, and during the third and fourth years the population returned to more normal numbers. Some observations were made on changes in the bottom fauna in both the littoral and deeper waters of the loch, and the results suggest that there was a significant numerical increase in these animals, especially in the littoral zone, following fertilization. The results of this experiment are compared with those obtained by other investigators, and a bibiliography of 42 references is appended.

2152. Timmermans, J. A. 1957. ESTIMATION OF FISH POPULATIONS. Trav. Sta. Rech. Groenendael, Ser. D., No. 21, 84 pp.; Water Pollution Abstracts, Vol. 31, No. 11, Abst. No. 2115. 1958.

Methods for determining fish populations in bodies of water are described, and the results of determinations in some swiftly flowing waters of Belgium are discussed. Fishing was done electrically. The method of estimation most often used was by marking and recapture; satisfactory results were obtained.

2153. Spaas, J. T. 1958. CONTRIBUTIONS TO THE COMPARATIVE PHYSIOLOGY AND GENETICS OF THE EUROPEAN SALMONIDAE. I. METHOD FOR THE DETERMINATION OF THE OXYGEN CONSUMPTION IN OVA, ALEVINS, AND FISHES OF DIFFERENT SIZES. Hydrobiologia, Vol. 11, pp. 267-274; Water Pollution Abstracts, Vol. 31, No. 11, Abst. No. 2117. 1958.

The method used to study the oxygen consumption of ova and fish of the Salmonid group is described. The oxygen concentration in the water was measured before and after passing through the respiration chamber containing the organism, care being taken that the water is not contaminated with atmospheric air between these two determinations. From the difference in oxygen concentration and the rate of flow it is possible to calculate the oxygen consumption per litre of water per hour.

2154. Tucker, D. S. 1958. THE DISTRIBUTION OF SOME FRESHWATER INVERTEBRATES IN PONDS IN RELATION TO ANNUAL FLUCTUATIONS IN THE CHEMICAL COMPOSITION OF THE WATER. J. Anim. Ecol., Vol. 27, pp. 105-123; Water Pollution Abstracts, Vol. 31, No. 11, Abst. No. 2121. 1958.

Variations in total hardness, total alkalinity, concentrations of calcium and magnesium, dissolved organic matter, and the pH value of the water and the bottom soil were studied in 16 ponds over a period of 14 months, in relation to the distribution of inverte-

brates in the ponds. The most important factors affecting the total numbers of animals present were found to be concentration of calcium, size of basin, and concentration of dissolved organic matter. Fewer species occurred in small soft-water ponds than in larger hard-water ponds, and it is suggested that this is caused by the greater concentrations of humic acids in the small basins.

2155. Anonymous. 1956. METHODS OF TESTING WATER: DETERMINATION OF pH VALUE. Standards Institution of Israel. Draft Standard No. 55/2. 3 3pp; Water Pollution Abstracts, Vol. 31, No. 11, Abst. No. 2139. 1958.

Procedure is given for potentiometric and colorimetric methods for determining the pH value of water.

2156. Vliet, R. V. 1957. EFFECT OF HEATED CONDENSER DISCHARGE WATER UPON AQUATIC LIFE. Amer. Soc. mech. Engrs, Pap., No. 57-PWR-4, 10 pp; Water Pollution Abstracts, Vol. 31 No. 11, Abst. No. 2242. 1958.

This paper is a summary of 2 progress reports on the work carried out by the Lehigh University Institute of Research during 1956 to investigate the effects on aquatic life of discharging heated condenser circulating water from the Martins Creek steam-electric generating station of the Pennsylvania Power and Light Company into the Delaware river. The water requirements of the condensers are 60,000 gal per min for each of 2 units. The discharge canal was re-routed in 1955 so that the effluent now enters the river at a point where the natural rapids assist the distribution process; results of temperature measurements indicate that better mixing has been attained. Chemical tests, and tests for plankton, algae, rooted aquatic plants, invertebrates, and river fishes were made at various points in the discharge canal and in the river upstream and downstream from the junction with this canal. No unexpected or unusual changes have been found in any of the chemical characteristics of the water. Diatoms and similar species had previously shown highest counts in an area of the river near a railway bridge; the advantage of this area for the growth of such organisms appears to be eliminated by the low water in the summer and the higher temperatures. The growth of algae has been stimulated in the various streams and channels near the plant, owing to the effect of both heat and minerals; this result has not yet been detected in the river. Most of the observed patches of rooted plants were below the effluent discharge point, but their distribution has not yet been definitely correlated with that of heated water. The warm water was found to favour the growth of certain species of invertebrates such as midges, snails, and caddis fly larvae; some species were, however, only found in the cold water, especially the Tardigrade, or "water bear" which was very abundant in cold but completely absent from warm water; it may be possible to use the Tardigrade as a water-temperature index organism, and its distribution at various points in the river is therefore being investigated. The warm water does not appear to be deleterious to fish, but it seems to attract them, owing to their food preferences and tolerance of the higher temperature; in the summer unusually high numbers of small-mouth bass were found at the point where the effluent met the river water. Towards winter fish tended to move to the effluent canal as the river water became cooler. The species and characteristics of fish in the Martins Creek area are being studied. Tests to determine the heat tolerance of various river fish were made using a metal tank in which hot or cold water could be added to the normal stream at 16 different points so as to obtain a regular temperature variation from cold at the inlet end to hot at the outlet end or vice versa. Most, but not all, species of fish were sufficiently sensitive to heat to prevent them entering the hot water until they had become acclimatized to the heat. Some species died without any effort to return to the cooler water and some species were able to undergo a change of 30° to 40°F with no deleterious effects. These studies are to be continued and will include experimental work with the walleyed pike which is one of the important game fish of the river.

2157. Stammer, H. A. 1958. TOXICITY TOWARDS FISH SHOWN BY VARIOUS SLIME-CONTROLLING AGENTS USED IN THE PAPER AND PULP INDUSTRY. Papier, Darmstadt, Vol. 12, pp. 41-44; Water Pollution Abstracts, Vol. 31, No. 11, Abst. No. 2243. 1958.

The toxicities to rainbow trout yearlings of 7 different commercial chemicals used for controlling slime in the pulp and paper industry were investigated. All were found to be toxic, and it is probable that fish may be damaged in streams receiving such chemicals even in concentrations below the toxic concentration observed in the laboratory, particularly in the case of fish spawn and when the chemicals are present for long periods without adequate dilution.

2158. Hoffman, R. A. 1957. TOXICITY OF THREE PHOSPHORUS INSECTICIDES TO COLD WATER GAME FISH. Mosquito News, Vol. 17, p. 213; Water Pollution Abstracts, Vol. 31, No. 11, Abst. No. 2245. 1958.

In tests carried out to determine whether effluents from drainage systems where fly control methods had been used would be dangerous to fish, three phosphorus compounds were tested. Parathion in concentrations of 0.05, 0.1, 0.5, and 1.0 p.p.m. did not damage brook or rainbow trout so that the concentration generally used in insect control (0.01 p.p.m.) would be harmless. Phosdrin in concentrations of 0.05 p.p.m. completely destroyed trout and symptoms of poisoning were caused by exposure to 0.01 p.p.m. for 180 hours. Dipterex caused no damage in concentrations of 1 and 10 p.p.m., so that its use for fly control is not dangerous.

2159. Herbert, D. W. M., and H. T. Mann. 1958. THE TOLERANCE OF SOME FRESH-WATER FISH

FOR SEA WATER. Salm. Trout Mag., No. 153, pp. 99-101; Water Pollution Abstracts, Vol. 31, No. 11, Abst. No. 2246. 1958.

In order to determine the tolerance of some fresh-water fish for sea water, an experiment was carried out with roach (Rutilus rutilus, L.) and perch (Perca fluviatilis, L.) to observe the effect of transferring them suddenly from the fresh water to mixtures of fresh and sea water. It was found that the perch could withstand about $1\frac{1}{2}$ times the salinity tolerated by roach, and it appears that perch could tolerate a sudden rise in the salinity to about 45 per cent sea water for several days, but that roach could tolerate only about 30 per cent.

2160. Fitzgerald, G. P. 1957. THE CONTROL OF THE GROWTH OF ALGAE WITH CMU. Trans. Wis. Acad. Sci. Arts Lett., Vol. 46, pp. 281-294. Water Pollution Abstracts, Vol. 31, No. 11, Abstract No. 2251. 1958.

CMU (3-(p-chlorophenyl)-1, 1-dimethylurea) was previously found to be toxic to algae. Tests have now been carried out on its use to control the growth of algae in the presence of other organisms, as in aquaria. Several species of algae (12 blue-green, 8 green, and 2 diatom species as well as mixed wild populations), various higher plants, including duckweed and Elodea canadensis, and 7 species of fish were subjected to the action of serial concentrations of CMU and of other chemicals. The results are tabulated. Algal growth was prevented by concentrations of 0.5-1.0 p.p.m. CMU, whereas 2 to 5 times this concentration were required to cause apparent adverse effects in the higher plants tested, and concentrations as high as 40 p.p.m. showed no adverse effects on fish. Considerably higher concentrations were required to kill an established algal culture than to prevent the growth of an inoculation of algae. CMU is therefore recommended for use in preventing the further growth of algae after the previous algal population has been reduced by other means. Comparison of the toxicity of CMU with that of related compounds showed that the toxicity to algae increased with the halogen content of the molecule. Compounds such as 3-(3,4-dichlorophenyl)-1, 1-dimethylurea (DW), which contain more halogen than CMU and are therefore more toxic to algae, may, however, be more toxic to fish or less selective in their action on aquatic plants.

2161. Lodge, M., and P. C. G. Isaac. 1958. CONTROL OF ALGAE IN A RESERVOIR. Univ. Durham, King's Coll., Dept. civ. Engng, Bull. No. 12, p. 13; Water Pollution Abstracts, Vol. 31, No. 11, Abst. No. 2252. 1958.

In order to determine the best algicidal treatment for a reservoir in the northeast of England, weekly examinations were made in February-August, 1957, to determine the nature and the amount of algae present, and screening tests with various algicides were carried out. The effects of algicidal treatments on the algal population are shown graphically. Copper sulphate was at first considered the most suitable algicide but chlorine later proved more valuable. Throughout the test period, the algal flora was predominantly chlorophycean, but an autumn peak of diatoms later replaced the green algae.

2162. Schiemenz, F. 1957. THE SPECIAL IMPORTANCE OF AQUATIC PLANTS FOR FISHERIES AND STREAM MAINTENANCE IN SMALL FLOWING WATERS. Wass. u. Boden, Vol. 9, pp. 208-215; Water Pollution Abstracts, Vol. 31, No. 12, Abst. No. 2311. 1958.

In view of the importance of aquatic plants for fish and as a suitable environment for growth of organisms forming the food of fish serious damage may be caused by removal of weeds in the clearing of streams. The author gives a diagram showing individual number of animals, numbers of types, and weight in open water, sand beds, sludge deposits, and plant masses. Discussing the real importance of damage to the stream and to fishing equipment ascribed to weeds, the author concludes that conditions vary with different types of plant life and that in clearing attention should be paid to the type of plant as some are not only harmless but desirable.

2163. Nümann, W. 1957. NATURAL AND ARTIFICIAL "RED WATER" WITH CONSEQUENT DEATH OF FISH IN THE SEA. Arch. Fischereiwiss., Vol. 8, pp. 204-209; Water Pollution Abstracts, Vol. 31, No. 12, Abst. No. 2312. 1958.

The author describes investigations of two occurrences of red tide, accompanied by death of fish, one in the Bay of Luanda (Portuguese West Africa) and the other in the Bay of Izmir (Smyrna). Red tide is caused by sudden mass development of phytoplankton in coastal waters rich in nutrient matter and the mass development is stimulated by substances carried in by fresh water. Mass development is confined to the upper 10m where fish may be killed by the mass of plankton. Death of fish in deeper layers is caused by oxygen shortage due to decomposition of deposited dead plankton.

2164. Beauchamp, R. S. A. 1958. UTILIZING THE NATURAL RESOURCES OF LAKE VICTORIA FOR THE BENEFIT OF FISHERIES AND AGRICULTURE. Nature, Lond., Vol. 181, pp. 1634-1636; Water Pollution Abstracts, Vol. 31, No. 12, Abst. No. 2318. 1958.

Utilization of the natural resources of lake Victoria for the benefit of fisheries and agriculture is discussed. Analyses of the bottom mud deposits of lake Victoria are reviewed; the mud is rich in organic sulphur and proteins. Gill-net fishing has greatly depleted the stocks of Tilapia in the lake over the past 50 years and restocking, swamp clearance and reclamation are recommended to counteract this. Partial cost of swamp clearance may be recovered by composting the resulting papyrus and converting some of the other aquatic plants and grasses into silage for cattle. Areas choked by vegetation could be reclaimed by adding fertile lake mud to convert

them into productive market gardens. Water draining into the lake from these reclaimed and cultivated areas should lead to an increase in plankton production and so to an increased production of fish. Further uses for the mud deposits as a fertilizer and for pig food are discussed. Feeding experiments carried out on rats showed that they made no use of the protein but future research may result in a process which will make the protein in the mud more available.

2165. Adlung, K. G. 1957. THE TOXICITY OF INSECTICIDAL AND ACARICIDAL AGENTS TO FISH. Naturwissenschaften, Vol. 44, pp. 471-472; Water Pollution Abstracts, Vol. 31, No. 12, Abst. No. 2445. 1958.

A table is given of the results of experiments on the toxicity of a number of insecticidal and disinfectant compounds to the fish Lebistes reticulatus. For comparison the lethal doses for rats are given. The substances tested include pyrethrum, rotenone, a number of chlorinated hydrocarbons and of phosphoric acid esters, and the soil disinfectant Vapam.

2166. Adlung, K. G. 1957. THE TOXICITY OF INSECTICIDES TO FISH AND ITS DEPENDENCE ON TEMPERATURE. Naturwissenschaften, Vol. 44, pp. 622-623; Water Pollution Abstracts, Vol. 31, No. 12, Abst. No. 2446. 1958.

The author gives the results of further experiments on the toxicity of a number of insecticides to fish, using young goldfish and Lebistes reticulatus. The chlorinated hydrocarbons Toxaphene, Thiodan, and Isodrin were found to be highly toxic. Experiments were made to test the effect of the temperature on the lethal dose and on the progress of the toxic action. Temperature had little effect on the absolute lethal dose but decrease in temperature delayed the progress of the toxic action. The critical period after which damage done to the fish was not reversible on transference to clean water was 25 times as long at 4° and 11°C as at 19°C.

2167. Polonovski, M., and A. Lindenberg, 1952. NARCOTICS AND TOXICITY TO FISH. Arch. int. Pharmacodyn., Vol. 90, pp. 71-77; Water Pollution Abstracts, Vol. 31, No. 12. Abst. No. 2447. 1958.

The authors describe investigations into the toxicity to fish and the method of action of a number of narcotic substances.

2168. Bandt, H. J. 1957. TOXIC OR NON-TOXIC TO FISH? Dtsch. FischZtg, Vol. 4, pp. 170-171. Water Pollution Abstracts, Vol. 31, No. 12, Abst. No. 2448. 1958.

The author describes the results of practical experience and experiments on the toxicity of substances to fish. A chlorinated camphene (Toxaphene) used to control field mice was washed by rain into a stream and caused death of fish. Experiments showed that the preparation was toxic to rainbow trout and carp in amounts of 1.25 mg per litre (equivalent to 0.125 mg of the active principle per litre). Dyes used in hydrological investigations (eosin, fluorescein, and uranin) in concentrations up to 100 mg per litre were found to be non-toxic to trout and roach. Acid nitration water from an explosives factory caused death of fish in the Spree. The waste waters contained up to 5 g per litre of an ether-extractable nitro-compound, the toxic limit of which to perch was found to be 5 mg per litre.

2169. Anonymous. 1958. DEADLY MIX. Chem. Engng News, Vol. 36, No. 16, p. 70; Water Pollution Abstracts. Vol. 31, No. 12, Abst No. 2449. 1958.

Experiments by Chanin, G., and Dempster, R. P., have shown that while certain chemical waste waters are not toxic to fish in sea water under normal conditions, they may become toxic if the pH value of the water is lowered. Waste waters containing acidic compounds may therefore cause the death of fish. However experiments also showed that reduction of the pH value to 5.5 in the presence of individual constituents of the waste waters did not kill fish, and it is concluded that the various compounds must have a synergistic or additive toxic effect at low pH values.

2170. Clemens, H. P. and K. E. Sneed. 1958. EFFECT OF TEMPERATURE AND PHYSIOLOGICAL CONDITION ON TOLERANCE OF CHANNEL CATFISH TO PYRIDYLMERCURIC ACETATE (PMA). Progressive Fish-Culturist. Vol. 20, No. 4, pp. 147-150.

The tolerance of fingerling channel catfish (Ictalurus punctatus) to pyridylmercuric acetate (PMA) increases as the water temperature decreases. This relationship existed for all exposure periods up to 153 hours. The LD_{50} for yolk-sac fry exposed 24 hours was above 5ppm; for 1-week-old fry it was 2.18 ppm; for 3-inch fingerlings 2 months old it was 3.75 ppm. Trough-reared fish treated occasionally with PMA withstood less chemical than pond-reared fish which had no previous PMA treatments or trough-reared fish which had received frequent PMA treatments. It was believed that the fish treated less frequently were weaker from disease and parasites than the fish in the latter two categories. No acquired tolerance to PMA treatments was demonstrated. A 4.5-hour exposure to concentrations above 1 ppm. caused delayed mortalities in week-old fry. Similar fish exposed 1 and 2 hours exhibited no delayed mortality. (H. P. C.)

2171. Nielson, Reed S. 1958. HAULING AND HANDLING OF HATCHERY TROUT. Progressive Fish Culturist. Vol. 20, No. 4, p. 150.

No differential early post-planting mortality was observed between trout transported in light loads, i.e. 150 pounds per 150-gallon tank, and heavy loads, i.e. 300-350 pounds per 150-gallon tank, between a long 12.5-hour trip and a short 1.75-hour trip at same load level, and between initially healthy robust trout that have been carefully handled while being drugged for hauling and marking, and those not drugged.

2172. Deelder, C. L. 1958. MODERN FISH

PASSES IN THE NETHERLANDS. Progressive Fish Culturist, Vol. 20, No. 4, pp. 151-154.

Until the 1920's, salmon, sea trout, eels, and other species either populated the River Meuse or used it as a road to their spawning grounds. When weirs of the overflow type were built in the Dutch part of the Meuse, passes of the Denil and pool type were constructed to facilitate the migration of salmon. These passes did not prevent the annihilation of the salmon population and loss of a profitable fishery. Reconsideration of the fish-pass problem from the biological point of view led to the development of the fish-lock type of pass. The operation and advantages of the hydraulic fish lock at Lith on the River Meuse are described. (Auth. abst.)

2173. Iyatomi, K., T. Tamura, Y. Itazawa, I. Hanyu, and S. Sugiura. 1958. TOXICITY OF ENDRIN TO FISH. Progressive Fish-Culturist. Vol. 20, No. 4, pp. 155-162.

Endrin, a cyclodiene insecticide, becomes less toxic to fish as the temperature of the water is lowered. LD_{50} for the carp (Cyprinus carpio) 48 hours after treatment was 0.14 ppm. at 7° to 8°C., and 0.005 ppm. at 27° to 28°C. Eggs and larvae of fish are far more resistant to Endrin than adults: LD_{50} for the carp eggs 24 hours after treatment at 20°C was 19.9 ppm, and that of larvae about 2 days old was 10.7 ppm. When 400 g of Endrin per acre was applied in a paddy-field, its toxicity might remain for more than a month. The toxicity of the granular form of Endrin seemed to remain longer than that of dust or emulsion. When Endrin was applied in 0.25 acre of paddy-field, the toxicity to fish was recognized in the adjacent area within about 100 m from the treated field, although the toxic effects differed according to the conditions of the waterway from the field. (K. I.)

2174. Allen, G. H. 1958. NOTES ON THE FECUNDITY OF SILVER SALMON (ONCORHYNCHUS KISUTCH). Progressive Fish-Culturist. Vol. 20, No. 4, pp. 163-169.

The eggs from 63 silver salmon returning to the University of Washington in the 1953-54 migration season were maintained as separate lots. A relationship between length of fish and numbers of eggs was computed. Large fish tended to produce larger eggs and small fish smaller eggs. There was no relationship between size of egg and numbers of eggs produced by individual females. The fecundity relationships of silver salmon from three different areas were compared. The average fecundity of populations of silver salmon from the west coast of North America was tabulated. A sizable difference in average fecundity for the 1950 brood year silver salmon returning to the University of Washington and to Minter Creek was demonstrated. Use of published data on fecundity of silver salmon to estimate potential egg deposition, knowing only the total number of salmon in an area, would be hazardous. (Auth. abst.)

2175. Brezner, Jerome, 1958. FOOD HABITS OF THE NORTHERN RIVER CARPSUCKER IN MISSOURI. Progressive Fish-Culturist, Vol. 20, No. 4, pp. 170-174.

One hundred northern river carpsuckers, Carpiodes carpio carpio (Rafinesque), taken from Lake of the Ozarks, Missouri, were examined and their gut contents analyzed. The samples were examined first under a dissecting microscope at 3 diameters and then under a compound microscope at 100 diameters.

Observations showed that material which had heretofore been termed "unidentifiable" was, in reality, recognizable plankton material. The following conclusions were reached: (a) the carpsucker is not a mud feeder; (b) the carpsucker is not a scavenger on waste and decaying organic matter; and (c) the carpsucker is probably a browser, feeding near the bottom and utilizing the periphyton associated with submerged rocks and debris. (Auth. summ.)

2176. Wilkinson, G. N., Jr. 1958. TRANSPORTING SMALL LIVE TROUT IN SEALED POLYETHYLENE BOTTLES. Progressive Fish-Culturist. Vol. 20, No. 4, pp. 175-179.

Adaptation of the plastic bottle as a replacement for the heavy cans or pails formerly used in distributing small live trout.

2177. Gibor, Ahron. 1958. A SIMPLE TECHNIQUE USED FOR LABORATORY HATCHING AND REARING OF FISH. Progressive Fish-Culturist. Vol. 20, No. 4, pp. 180-182.

A simple procedure based on the balanced-aquarium principle was successfully used in hatching eyed sockeye salmon (Oncorhynchus nerka) and green silver salmon (O. kisutch, Walbaum) eggs. The eggs were incubated together with green aquatic plants in a continuously illuminated aquarium. The silver salmon fry were reared under these conditions to the swimming-up stage. Of several aquatic plants examined, best results were obtained with a suspension of unicellular green algae in which a Chlorella was the dominant form. (Auth. abst.)

2178. Johnson, H. E. and J. M. Shelton. 1958. MARKING CHINOOK SALMON FRY. Progressive Fish-Culturist. Vol. 20, No. 4, pp. 183-185.

Experimental marking by excising fins of unfed fall chinook salmon fry of the 1955 brood year revealed that the only satisfactory two-fin marks were right or left pectoral and adipose. In a full-scale marking project with 1956 brood fry, these two marks were applied to 487,000 salmon. The fry averaged 1,077 per pound and 1.4 inches in total length when marked. The fish marked by the adipose and left pectoral fins were released immediately after being marked, and those marked by the adipose and right pectoral fins were reared for 91 days before their release. A small group of the marked salmon retained at the hatchery were examined 4 months after the marking and were found to have excellent marks with very little fin regeneration. (H. E. J.)

2179. Hanson, Harley. 1958. OPERATION FISH RESCUE. Progressive Fish-Culturist, Vol. 20,

No. 4, pp. 186-188.

An effective method for rescuing northern pike from shallow "freeze-out" lakes in Minnesota is described. Prior to winter, 2 channels, each 3 feet by 2 feet deep by 50 feet long are dug back from the shore to simulate an inlet and outlet stream. A pump drawing water from one channel pumps oxygenated water into the other. The pump is operated to provide attractive flow at such times as oxygen content in the lake is low. Traps in each channel collect the fish. Inflow and outflow collections have varied from year to year. In one winter season, 52,699 northern pike weighing 20,861 pounds were taken from one 1,454-acre lake.

2180. Fukano, K. G., and F. F. Hooper. 1958. TOXAPHENE (CHLORINATED CAMPHENE) AS A SELECTIVE FISH POISON. Progressive Fish-Culturist. Vol. 20, No. 2, pp. 189-190.

The epilimnion of a small Michigan lake was treated with 0.005 ppm of emulsifiable toxaphene concentrate. Five gill nets of varying mesh sizes set before treatment caught 26 fish; 1 week after treatment the same netting effort yielded 34 fish. These results suggested that the larger fish were not affected by the toxicant. This belief was supported by failure to find any large dead fish after treatment. The effect of the toxicant on fish less than 3 inches long was evaluated by shoreline seining. Before treatment 838 fish were captured in 40 hauls, and 1 week after treatment only 8 fish were caught with the same effort. The poor seine catch after treatment and observations of large numbers of small dead fish indicated that few fish less than 3 inches long had survived. These results suggested that a concentration of 0.005 ppm of toxaphene can be used to reduce the population of small fish in hard-water lakes without greatly affecting the larger individuals. (K. G. F.)

2181. Uzmann, J. R., and M. N. Hesselholt. 1958. TERATOLOGICAL HERMAPHRODITISM IN THE CHUM SALMON, ONCORHYNCHUS KETA (WALBAUM). Progressive Fish-Culturist, Vol. 20, No. 4, pp. 191-192.

A hermaphroditic chum salmon from Hokkaido, Japan, is described and pictured. The specimen is classified as a true male exhibiting latent but nonfunctional female characteristics. (J. R. U.)

2182. Semenov, K. I. 1957. THE EFFECT OF DIFFERENT LIGHT CONDITIONS ON THE DEVELOPMENT OF STURGEON LARVAE IN THE PERIOD FROM HATCHING TO TRANSITION TO ACTIVE FEEDING (ARTIFICIAL BREEDING). Doklady Akademia Nauk SSSR, Biological Sciences Section, Vol. 113, No. 4, pp. 248-251.

Five series of experiments involving 12,000 larvae were conducted. Each series included lighting by direct sunlight, complete elimination of light, and a control with moderately bright daylight. One series also included lighting with moderate intensity of red, blue, and green. Each experiment in a series ran for 12-17 days; controlled lighting being maintained over the first 8-10 days and all larvae spending the remaining days under identical conditions.

Larvae grew best and developed most typically in experiments with low intensity, daylight and colored light, as well as total darkness. Direct sunlight had a profound effect on the bulk of the larvae, producing various pronounced anomalies of structure and repressing their growth. There is evidence that direct sunlight inactivates blood catalase in fish and this evidently interferes unfavorably with their physiological processes of oxidation.

2183. Day, C. Godfrey. 1958. SURFACE CIRCULATION IN THE GULF OF MAINE AS DEDUCED FROM DRIFT BOTTLES. U. S. Fish and Wildlife Service Fishery Bulletin 141, Volume 58, pp. 443-472.

Drift-bottle returns from 17 cruises over the Gulf of Maine and Georges Bank are compared. Seasonal and year-to-year differences in surface water circulations are noted. Wind values for 60 days following each cruise are presented in an effort to determine wind influence on surface circulation within the area. (Auth. abst.)

2184. Talbot, Gerald B., and James E. Sykes. 1958. ATLANTIC COAST MIGRATIONS OF AMERICAN SHAD. U. S. Fish and Wildlife Service Fishery Bulletin 142, Volume 58, pp. 473-490.

The returns from 17,508 American shad (Alosa sapidissima) tagged at various places along the Atlantic coast over a period of 19 years have been used to study the migrations of this fish. Thirty-nine percent of these tags were recovered. These recoveries disclose that after spawning, adult shad from Chesapeake Bay to the Connecticut River migrate northward and spend the summer and fall in the Gulf of Maine. Canadian shad migrate southward to spend the same period in the Gulf of Maine. There is only slight evidence as to where shad spend the winter months, but it appears that they are scattered along the Middle Atlantic area, probably in deep water, for beginning in January or February as the spawning season approches they move inshore and shad which spawn from Georgia to the St. Lawrence River are caught from North Carolina to Long Island. Those not caught migrate either north or south to their native streams and spawn, repeating this cycle each year if they escape natural and fishing mortalities. The young shad leave their native streams in the fall; probably spend the winters in the Middle Atlantic area, migrate to the Gulf of Maine each summer along with the adults; and when mature return to their native streams to spawn. Those shad that spawn in streams south of Chesapeake Bay and particularly south of North Carolina die after spawning. How or by what mechanism shad and other anadromous fishes are guided in their migrations has not yet been satisfactorily determined. (Auth. abst.)

2185. Nichols, Paul R. 1958. EFFECT OF NEW JERSEY-NEW YORK POUND-NET CATCHES ON SHAD RUNS OF HUDSON AND CONNECTICUT RIVERS. U. S. Fish and Wildlife Service Fishery Bulletin 143, Volume 58, pp. 491-500.

A shad-tagging study conducted off the New Jersey-New York coasts during the spring of 1956 indicated that the New Jersey-New York ocean pound-net shad catch was composed of 76 percent Hudson River shad and 13 percent Connecticut River shad. Since the majority of shad caught off the coasts of New Jersey and New York are native to the Hudson and Connecticut Rivers, large ocean catches in any one year could affect the size of runs available to these rivers. The New Jersey-New York coastal shad catch has no effect on the deviations that occur between calculated and predicted size of Hudson River and Connecticut River shad runs. It was found that the New Jersey-New York pound-net shad catch is dependent on the size of the Hudson River shad population. (Auth. abst)

2186. Anderson, William W. 1958. LARVAL DEVELOPMENT, GROWTH, AND SPAWNING OF STRIPED MULLET (MUGIL CEPHALUS) ALONG THE SOUTH ATLANTIC COAST OF THE UNITED STATES. U. S. Fish and Wildlife Service Fishery Bulletin 144, Volume 58, pp. 501-519.

The larval and juvenile development of the striped mullet (Mugil cephalus) is described and illustrated from about 4 mm. to 116 mm. standard length.

Striped mullet appear to spawn along the south Atlantic coast of the United States from lower Florida to North Carolina over a broad area extending from about the 20-fathom line into the Gulf Stream. The data indicate that spawning occurs from October to February, but is confined largely to the period of November to January, with the peak in December.

Young striped mullet apparently remain at sea until they are from 18 to 28 mm. long (mostly 20 to 25 mm.), at which time they move in to the coast. In Georgia these young appear as early as November on the outer beaches but apparently do not go into the marshy estuarine waters until January.

Growth of young striped mullet in Georgia is estimated. They grow slowly during the colder winter months, but with the warming of the waters in spring growth speeds up. From about March to October the size increase is about 17 mm. a month. Mullet from the earliest spawning (October) reach a length of about 160 mm. standard length by the end of their first year. Growth of mullet as estimated by various workers along the south Atlantic and Gulf coasts of the United States is summarized.

Development of teeth on the tongues of young mullet and loss in the adult are described and illustrated. (Auth. abst.)

2187. Gangmark, Harold A., and Richard G. Bakkala 1958. PLASTIC STANDPIPE FOR SAMPLING STREAMBED ENVIRONMENT OF SALMON SPAWN. U. S. Fish and Wildlife Service, Department of Interior, Special Scientific Report--Fisheries No. 261, 20 pgs.

Knowledge of prevailing conditions of streams for spawning salmon can lead to improved management of those streams and improved production of salmon. All-important to the salmon is the condition of the streambed, based both on the characteristics of seepage rate and on the availability of oxygen at spawn depth. At Mill Creek, California, the most feasible method for procuring this information is by using the standpipe system. This paper describes the design of the Mill Creek Standpipe and its method of operation, discusses the mechanics of seepage, and compares the data obtained with data on the survival of king salmon spawn. (Auth. abst.)

2188. Seabloom, Robert Wendell. 1958. WATER QUALITY STUDIES IN THE WENATCHEE RIVER BASIN. U. S. Fish and Wildlife Service, Department of Interior, Special Scientific Report--Fisheries No. 268, 35 pgs.

A study of the physical and chemical characteristics of water was made in the Wenatchee River Basin during 1954, 1955 and 1956 to provide a basis for comparison to determine the effect of impoundment on water quality in relation to the preservation of fish resources.

The waters were characterized by an extremely low content of suspended and dissolved matter, a very low hardness and alkalinity, a practically neutral pH, and a saturation with dissolved oxygen. Seasonal variations were noted in most constituents.

The Wenatchee River is capable of conserving and supplying waters of excellent physical and chemical quality. (Auth. abst.)

2189. Holmes, Robert W., et. al., 1958. PHYSICAL, CHEMICAL, AND BIOLOGICAL OCEANOGRAPHIC OBSERVATIONS OBTAINED ON EXPEDITION SCOPE IN THE EASTERN TROPICAL PACIFIC, NOVEMBER-DECEMBER 1956. U. S. Fish and Wildlife Service, Department of Interior, Special Scientific Report--Fisheries No. 279. 117 pgs.

This SCOPE report describes the methods employed, lists in tabular form the results obtained, and includes a series of papers which discuss the results of a preliminary analysis of certain of the biological observations which were obtained on a cruise to the Eastern Tropical Pacific accomplished by the University of California, Scripps Institution of Oceanography, under Contract No. 14-19-008-2485 with the Department of Interior, U. S. Fish and Wildlife Service. Scientific personnel, equipment, and financial support for the data analysis have been largely provided by the University of California, Scripps Institution of Oceanography and the Inter-American Tropical Tuna Commission.

Information was obtained on the vertical and horizontal variations in temperature, salinity, dissolved oxygen, inorganic phosphorus, nitrite, alkalinity, pH, chlorophyll "a", primary production, bacterial abundance, and zooplankton standing crop. A nearly continuous record of incident solar radiation was obtained and was accompanied by daily measurements of the attenuation of blue-green light in the ocean. Water samples and fine-mesh net-hauls were collected for the subsequent analysis of phytoplankton abundance and species composition. The distribution of vertebrates was also studied with special emphasis on oceanic bird distribution.

Nine scientific papers which are the result of an

analysis of certain of the SCOPE data are included in Part 2 of this report. They are: Possible application of a bacterial bioassay in productivity studies, by William Belser; SCOPE measurements of productivity, chlorophyll "a", and zooplankton volumes, by R. W. Holmes, M. B. Schaefer, and B. M. Shimada; Size fractionation of photosynthesizing phytoplankton, by Robert W. Holmes; Diurnal variation in the photosynthesis of natural phytoplankton populations in artificial light, by Robert W. Holmes and Francis T. Haxo; Attachment of marine bacteria to zooplankton, by Galen E. Jones; Preliminary studies of bacterial growth in relation to dark and light fixation of $C^{14}O_2$ during productivity determinations, by G. E. Jones, W. H. Thomas, and F. T. Haxo; The effects of organic and inorganic micronutrients on the assimilation of C^{14} by planktonic communities and on bacterial multiplication in tropical Pacific sea water. by Galen E. Jones and William H. Thomas; The vertebrates of SCOPE, November 7 - December 16, 1956, by Robert Cushman Murphy; The alcohol-soluble and insoluble fractions of the photosynthetically fixed carbon in naturally occurring marine phytoplankton populations, by William H. Thomas. (Auth. abst.)

2190. Aller, Barbara B. 1958. PUBLICATIONS OF THE UNITED STATES BUREAU OF FISHERIES 1871-1940. U. S. Fish and Wildlife Service, Department of Interior, Special Scientific Report--Fisheries No. 284, 202 pgs.

2191. Jensen, Albert C. 1958. CORROSION RESISTANCE OF FISH TAGGING PINS. U. S. Fish and Wildlife Service, Department of Interior, Special Scientific Report--Fisheries No. 262. 6 pgs.

Aquarium-held haddock were tagged with nickel and Type 304 stainless steel pins to compare the corrosion resistance of the two metals. The stainless steel pins proved to be superior. (Auth. abst.)

2192. Craddock, Donovan R. 1958. SPAWNING ESCAPEMENT OF OKANOGAN RIVER BLUEBACK SALMON (ONCORHYNCHUS NERKA), 1957. U. S. Fish and Wildlife Service, Department of Interior, Special Scientific Report--Fisheries No. 275. 8 pgs.

The blueback salmon spawning area of the Okanogan River has been surveyed extensively each year since the start of a Canadian flood-control project in 1951. The spawning populations have been estimated and their distribution above Rock Island Dam determined. The large number of fish unaccounted for may be partially attributed to mortalities caused by the high water temperatures existing in the Okanogan River prior to spawning.

The age, length, and sex composition of the 1957 Okanogan River spawning escapement were determined from samples collected on the spawning grounds. Although some delay in passage occurred at the thirteen newly completed drop structures, completeness of spawning was not abnormally low.

The occurrence of large numbers of 3$_2$'s in the spawning population seems to be peculiar to the Okanogan River.

The distribution of fish on the spawning grounds has not changed appreciably since 1952. (Auth. abst)

2193. Rounsefell, George A., and John E. Evans. 1958. LARGE-SCALE EXPERIMENTAL TEST OF COPPER SULFATE AS A CONTROL FOR THE FLORIDA RED TIDE. U. S. Fish and Wildlife Service, Department of Interior, Special Scientific Report--Fisheries No. 270. 57 pgs.

The first large-scale attempt at controlling the red tide was made in the autumn of 1957. About 16 square miles stretching along 32 miles of shoreline from Anclote Key to Pass-a-grille Beach, off St. Petersburg, Florida, were dusted with copper sulfate ($CuSO_4.5H_2O$) at about 20 pounds to the acre by crop-dusting planes. The copper very quickly reduced Gymnodinium breve, the red tide organisms, from several million to practically none per liter relieving the area of the respiratory irritation caused by the airborne toxin of G. breve. In 2 out of 5 areas the organisms rose again to concentrations lethal to fish in 10 to 14 days after dusting. This method is not recommended for general control, but will give temporary relief in local situations from the airborne toxin. (Auth. abst.)

2194. Johnson, James H. 1958. SURFACE-CURRENT STUDIES OF SAGINAW BAY AND LAKE HURON, 1956. U. S. Fish and Wildlife Service, Department of Interior, Special Scientific Report--Fisheries No. 267, 84 pgs.

Surface currents of the waters of Saginaw Bay and lower Lake Huron area were studied in the summer and fall of 1956. Drift bottles were used in Saginaw Bay and drift bottles together with the dynamic-height method were used in Lake Huron. A total of 2,650 drift bottles were released; 1,843 (69.5 percent) reply cards from the recovered bottles were returned.

Correlation appeared to be high in Saginaw Bay between direction of surface currents that moved these bottles and direction of winds. In Lake Huron this correlation was less apparent, although the drift of bottles was generally from west to east, seemingly under the influence of the prevailing westerly winds of this area. (Auth. abst.)

2195. McCrimmon, H. R. 1958. OBSERVATIONS ON THE SPAWNING OF LAKE TROUT, SALVELINUS NAMAYCUSH, AND THE POST-SPAWNING MOVEMENT OF ADULT TROUT IN LAKE SIMCOE. The Canadian Fish Culturist. Issue Twenty-three, pp. 3-11.

The adult lake trout approached the spawning shoals during early October in each of the study years when the surface water temperatures had dropped to between 52°F. and 57°F. Strong onshore winds occurred immediately before the arrival of the trout and would appear necessary to bring the trout to the shoals. The lake trout frequented the shoals for a pre-spawning interval between nine and 19 days before actual spawning began. A relationship observed between the duration of this period and the extent of

accumulated sunlight would seem worthy of further study.

The spawning period varied from nine to 16 days. Maximum spawning activity was reached within four days (except in one year), continued at a high level for from three to five days, then decreased rapidly with an exodus of trout from the shoals within the next three or four days. Strong onshore winds appeared to hasten the peak in spawning activity and thus shorten the overall spawning period.

Tagged lake trout from a specific spawning shoal became widely distributed in the lake at other seasons of the year, the recovery of over 10 per cent of these trout representing a mixing of trout from all spawning areas of the lake at least during the summer stagnation period. There was no evidence of a homing behaviour among the adult lake trout. (Auth. summ.)

2196. Fry, F. E. J. and J. C. Budd. 1958. THE SURVIVAL OF YEARLING LAKE TROUT PLANTED IN SOUTH BAY, LAKE HURON. The Canadian Fish Culturist. Issue Twenty-three, pp. 13-21.

To date planting of yearling stock has shown promise of being a feasible method to rehabilitate the lake trout population in the Great Lakes. In the absence of lampreys 2-50 per cent of such planted fish could have been expected to have reached maturity in South Bay. It is possible, but not yet proven, that maximum efficiency could be obtained with relatively small introductions, for the data suggest that about the same absolute number of lake trout have survived regardless of the number planted.

The stocks introduced into South Bay have behaved in growth and distribution in essentially the same manner as did the native stock.

When sea lamprey are present in substantial numbers, planted lake trout can still survive in numbers for several years and apparently become highly susceptible to lamprey attack only after reaching a certain critical size which in South Bay is approximately 20 inches fork length. It is improbable that any planted lake trout will survive to spawning in South Bay while the sea lamprey maintains its present population density there. (Auth. concl.)

2197. Annan, Murvel E. 1958. NOTES ON THE FOOD OF THE YOUNG OF THREE SPECIES OF PACIFIC SALMON IN THE SEA. The Canadian Fish Culturist. Issue Twenty-three, pp. 23-25.

During July, 1950, 206 specimens of pink, chum, and king salmon were collected. Stomach analysis showed no differences in the food selection among the 3 species or in relation to size of fish. Food materials of all specimens were 50 percent Copepoda, 26 percent Diptera, and 24 percent miscellaneous items including small Crustaceae.

2198. Murray, A. R. 1958. A DIRECT-CURRENT ELECTROFISHING APPARATUS USING SEPARATE EXCITATION. The Canadian Fish Culturist. Issue Twenty-three, pp. 27-32.

The unit is described and a brief report on some results of its use is given.

2199. Blair, A. A. 1958. BACK-BACK FISH SHOCKER. The Canadian Fish Culturist. Issue Twenty-three, pp. 33-37.

A 6-volt motorcycle battery, a Vibrapack, and a voltmeter housed in a fairly water-tight box and two paddle-type electrodes compose this shocker. Total weight is 44 pounds; cost in St. John's, Newfoundland, was $120.00. A list of parts and a schematic wiring diagram are presented.

2200. Stringer, George E., and Robert G. McMynn. 1958. EXPERIMENTS WITH TOXAPHENE AS FISH POISON. The Canadian Fish Culturist. Issue Twenty-three, pp. 39-47.

Eight alkaline lakes in British Columbia were treated with Toxaphene at concentrations ranging from 0.10 p.p.m. to 0.01 p.p.m. Effects on fish, bottom fauna and plankton were evaluated. Most of the fish were killed in all concentrations within the first 120 hours. While a few fish were gillnetted, two to three weeks after treatment, none were netted in any of the lakes eight to nine months after poisoning. The lakes were still toxic to fish nine months after treatment as determined by live cage tests. Amphipods (shrimp) were eliminated at all concentrations and were still absent nine months after treatment. Dragonfly and damselfly nymphs were killed at a concentration of 0.03 p.p.m., while midge larvae were killed at concentrations of 0.03 p.p.m. and greater. No consistent adverse effects were noted with respect to plankton. Toxaphene was indicated as being an effective and economical fish toxicant; further work is being carried out with respect to more dilute concentrations and length of toxicity. (Auth. abst.)

2201. McKenney, Thomas W., Elizabeth C. Alexander and Gilbert L. Voss. 1958. EARLY DEVELOPMENT AND LARVAL DISTRIBUTION OF THE CARANGID FISH, CARANX CRYSOS (MITCHILL). Bulletin of Marine Science of the Gulf and Caribbean, Vol. 8, No. 2, pp. 167-200.

The early development of the blue runner, Caranx crysos (Mitchill, 1815), is described and the early stages are illustrated. The distribution of the species is discussed based upon specimens in the collections of the Marine Laboratory and the United States National Museum. Food, spawning, growth, temperatures, salinities and depth of capture are discussed. (Auth. abst.)

2202. Ross, Robert D. 1958. SOME TAXONOMIC PROBLEMS OF SHENANDOAH RIVER FISHES. Technical Bulletin 137, Virginia Agricultural Experiment Station, Virginia Polytechnic Institute, 10 pgs.

The taxonomic position is discussed and morphometric data are presented for Etheostoma flabellare, Campostoma anomalum anomalum, Notropis hudsonius amarus, and Notropis amoenus.

2203. Smith, Lloyd L., Jr., Donald R. Franklin, and Robert H. Kramer. 1958. DEVELOPMENT OF QUANTITATIVE SAMPLING METHODS FOR YOUNG OF THE YEAR FISH. Completion Report Investiga-

tional Projects. State of Minnesota, Dingle-Johnson Project Number F12R, Job Number 1, 58 pgs.

An electric seine for use on small fish in shallow water was designed to use interrupted direct current from a 2,500-watt direct current portable generator. An electronic circuit activated a relay in the seine supply circuit. A square wave with duty cycle of 0.50 to 0.90 was formed at frequencies of 20 to 300 per minute. Tests made in a webbing enclosure in a lake showed 240 interruptions per minute at 230 volts was most effective in catching fish. The seine was boat-mounted and embodied a double row of vertical electrodes. Electrotactic response was low but the seine is satisfactory if efficiency levels can be determined for water quality, orientation of operation, and other variables encountered in normal field work. The reliability of bag seines for sampling populations of small fish was tested during 1955, 1956, and 1957 by using analysis of covariance to compare the regressions of successive catches throughout the season. The regressions were fitted to the logarithm of the catch (n fish + 1) because preliminary tests indicated that the variance increased directly with the size of the catch. The catches showed no significant correlation with illumination, and comparisons from year to year were as significant with only one sampling station as with several. Seines as short as 27 feet were reliable sampling tools for fish up to 2 inches in length, but larger fish were more reliable sampled with 50-foot seines. Regressions should be fitted to a minimum of 10 points (10 days spaced throughout the season) for best results, and refined difference judgements would require refinements in the experimental design. (Auth. abst.)

2204. Böhlke, James E. 1958. STUDIES ON FISHES OF THE FAMILY CHARACIDAE. NO. 16 --A NEW HYPHESSOBRYCON FROM COSTA RICA. Bulletin of the Florida State Museum, Biological Sciences, Volume 3, Number 4, pp. 173-178.

A new tetra of the genus Hyphessobrycon is described from the Tortuguero River in Costa Rica. While it is thought to be really close to none of the other known members of the genus, Hyphessobrycon compressus (Meek) and H. milleri Durbin are probably its closest allies. The species is also compared with the rhoadsiine, Rhoadsia eigenmanni (Meek), from near the same geographic locality. (Auth. synop.)

2205. Carlander, Kenneth D. 1958. SOME SIMPLE MATHEMATICAL MODELS AS AIDS IN INTERPRETING THE EFFECT OF FISHING. Iowa State Coll. Jour. Sci., Vol. 32, No. 3, pp. 395-417. Biol. Absts., Vol. 32, No. 10, Abst. No. 32837. 1958.

It is suggested that the possible effect of fishing on fish populations and catch can be studied with models involving mathematics no more complicated than simple algebra. In Model A, similar to that of Baranoff, populations accumulate to improbable magnitudes at low mortality rates. A Model C is proposed in which the population remains near a carrying capacity and recruitment, growth, and natural survival decrease as the population exceeds carrying capacity. Both numbers and poundage of fish in the catch increase as fishing pressure increases with Model C, whereas the Model A poundage reaches its peak with fishing mortalities of about 20% unless the natural mortality rate is over 40%. The numbers of large walleyes reach their peak in the catch with fishing mortalities of about 15% in Model A and of about 45% in Model C. If it is assumed that catch-per-unit-effort is proportional to population density, the number caught per unit effort is at the minimum in Model C with fishing mortalities of 30-40% and at highest fishing mortality rates with Model A. Fish populations do not have the extreme adaptability assumed for Model C, but limits tried with additional models, E and F, indicated that the adaptability must be considerably restricted to affect the general results in Model C. (Auth. abst.)

2206. Chizhova, T. P. 1956. DIPHLLOBOTHRIASIS IN THE KALININGRAD DISTRICT. (O DIFILLOBOTRIOZE KALININGRADSKOI OBLASTI.) Doklady Akad. Nauk SSSR, Vol. 108, No. 2, pp. 370-371; Biol. Absts. Vol. 32, No. 10, Abst. No. 32838. 1958. (Translation.)

In the dissection of 156 specimens of 6 species of fish from the Kursh Gulf of the Baltic Sea, plerocercoids of Diphyllobothrium latum were discovered only in pike. The intensity of infection was equivalent to 1-2 plerocercoids. Ruff, perch, bream, and eelpout were not infected. In 20 dissected sea gulls, diphyllobothrids were not detected. In these, parasitization with Ligula larvae was noted.

2207. Coleman, P. G. 1957. THE CHEMICAL CONTROL OF WATER HYACINTH IN KELANTAN. Malayan Agric. Jour. Vol. 40, No. 3, pp. 200-208; Biol. Absts., Vol. 32, No. 10, Abst. No. 32839. 1958.

Water hyacinth (Eichhornia crassipes) has become a serious problem in many areas of slow-moving water in Malaya. Despite legislation for destruction of this weed, it continues to multiply as it has done in other areas of the world. Use of a herbicide containing 2, 4-D and 2, 4, 5-T was found to be a very practical means for control of this plant. Complete destruction of water hyacinth does not appear to be practical because of reinfestation. It is of interest that no harm to fish was observed although the concentration used was fairly high. The cost of successful control was about $100.00/acre. (W. F. J.)

2208. Instituto de Investigaciones Pesqueras. (Inst. of Fisheries Res.) 1957. THIRD SYMPOSIUM ON "MARINE PRODUCTIVITY AND DEVELOPMENT OF FISHERIES" IN THE LABORATORY OF CASTELLÓN, SEPT. 10-14, 1957. (TÈRCERA REUNIÓN SOBRE "PRODUCTIVIDAD DEL MAR Y EXPLOTACIÓN PESQUERA" EN EL LABORATORIO DE CASTELLÓN, DEL 10 AT 14 DE SEPTIEMBRE DE 1957.) Patronato "Juan de la Cierva" de Investigación Técnica: Madrid. 121 p. Biol. Absts., Vol. 32, No. 10, Abst. No.

32845. 1958.

This is a mimeographed presentation of papers presented at the opening of the Laboratory of Castellón, in Cádiz, Spain, under the auspices of the Instituto de Investigaciones Pesqueras. There is an introduction by the Director, F. GARCIA del CID and 31 papers by various authors on: Standards of biological productivity in fisheries; Productivity and succession; Development of marine fishing in the South Atlantic region 1941 to 1955; Estimation of yields by ichthyological methods; Help which may be given to the study of fisheries by noting the total unloaded at a port; On fishing statistics in the dynamics of populations; Suspended and dissolved organic nitogen in the Vigo estuary; Advances in the study of the sardine; Application of intermittent submerged light in sardine fishing; Methods of study in the Castellón Laboratory; Increase in ash content in the muscle of Sardina pilchardus during the winter; Determination of phosphates in sea water; The pigments of sand and the nutrition of mollusks, Parapenaeus longirostris and other edible crustaceans of the South Atlantic; On the fishing of crustaceans in the deep waters of the Balearic Isles; Some problems of fishing by depth dredging; On the cartography of fishery depths; Criteria on commercial size; Seasonal prohibitions of dredging in the Mediterranean; Determination of organic matter in sea water; Some biological data and statistics on the Thunnus thynnus of Barbate; On the nutrition of juvenile stages of the horse mackerel and "jurel"; On the hydrography and planktology of the Vigo estuary; Seasonal abundance of Polydora in the Galician estuaries and problems caused thereby in oyster cultivation; Considerations on the differential growth of the head of fishes; Continuous determination by means of cables of the physico-chemical characters of water; On the cultivation of the mussel (Mytilus) in Galicia; Plankton nets; The carp of rice fields as a material for manufacture of flour; The problem of the age of cephalopods; Hydrographic study of the Vigo estuary (part 2).

2209. Muncy, R. Jess. 1958. MOVEMENTS OF CHANNEL CATFISH IN DES MOINES RIVER, BOONE COUNTY, IOWA. Iowa State Coll. Jour. Sci., Vol. 32, No. 4, pp. 563-571; Biol. Absts., Vol. 32, No. 10, Abst. No. 32854. 1958.

Metal strap tags were placed on the opercles of 3077 channel catfish (Ictalurus punctatus) released in a 7-mile stretch of the river. Only 7 returns, of 86 reported by anglers, came from outside the 7-mile area, 2 upstream and 5 downstream. Evidence indicates, however, that the catfish do not remain long in the same pool. Tag returns indicate a minimum angler harvest of 4.6% of the catchable-size fish. (G. H. N.)

2210. Paloumpis, Andreas A. 1958. RESPONSES OF SOME MINNOWS TO FLOOD AND DROUGHT CONDITIONS IN AN INTERMITTENT STREAM. Iowa State Coll. Jour. Sci., Vol. 32, No. 4, pp. 547-561; Biol. Absts., Vol. 32, No. 10, Abst. No. 32856. 1958.

During a 3-year period, some 29 species of fishes were collected from an intermittent stream in central Iowa. The stream experienced 2 drought years and 1 flood year during the period of study. The populations of most of the species are not large. Only the bigmouth shiner appears to be abundant. Most of the species have been successful in maintaining themselves regardless of drastic changes in habitat. Survival was achieved by use of flood plain ponds, migration to a lower river or to small tributary streams, and by use of isolated pools in the stream channel. (G. H. N.)

2211. Anonymous. 1957. STUDY REVEALS PIKE MOVEMENTS. Iowa Conservationist. Vol. 16, No. 10, p. 176; Biol. Absts. Vol. 32, No. 10, Abst. No. 32863. 1958.

Of 1,155 walleyes (Stizostedion vitreum) and saugers (S. canadense) tagged in the Mississippi River at Guttenberg, Iowa, 93 were reported caught by anglers. While 32 were taken from a few to 100 miles away, the remainder were caught in the vicinity released. (K. D. C.)

2212. Acolat, L. 1955. RESEARCHES RELATING TO THE REACTION OF THE ISOLATED HEART OF ESOX LUCIUS TO THE PASSAGE OF AN ELECTRICAL CURRENT. (RECHERCHES RELATIVES A LA RÉACTION DU COEUR ISOLÉ DU CROCHET (ESOX LUCIUS L.) AU PASSAGE DU COURANT GALVANIQUE.) Ann. Scient. Univ. Besancon. Zool. et Physiol., 1955, No. 4, pp 9-16; Biol. Absts., Vol. 32, No. 10, Abst. No. 33299. 1958.

In the isolated pike heart an electrical current (0.5 to 5.0 volts) stimulates contraction rate when the positive electrode is on the auricle and the negative on the bulbus arteriosus. Reversing the position of the two electrodes decreases heart rate. (R. W. P.)

2213. Mavrinskaya, L. F. 1956. MOTOR NERVE ENDINGS OF THE SKELETAL MUSCLES OF THE LOWER VERTEBRATES. (DVIGATEL'NYE NERVNYE OKONCHANIYA SKELETNYKH MYSHTS NIZSHIKH POZVONOCHNYKH.) Doklady Akad. Nauk SSSR, Vol. 106, No. 2, pp. 347-349; Biol. Absts., Vol. 32, No. 10, Abst. No. 33605. 1958. (Translation)

The motor nerve endings of the muscles of the abdominal fins of the perch, roach, and pike were studied, and also the roe-case and dorsal muscles in the frog. The motor endings of fish are characterized by the great length of the preterminal fibers. The terminal branches in the endings of fish are few in number, simply differentiated, fine, diverging from each other at an angle, are pointed or end in meshes and are accompanied by 1-2 Schwann nuclei. No principal nuclei or nuclei of the sheath were discovered in the endings. No special layer of protoplasm around the terminal nerve branches was detected. In a single muscle fiber, 2-5 nerve endings may be present. In the roe-case muscle of the frog, fan-shaped branchings of the nerve fibers are also observed. The motor nerve endings are found chiefly in the ventral muscle region. Simple filiform motor endings and bushy and terminal bundles were dis-

covered. The author considers "terminal bundles" a composite form of motor endings, consisting of several simple endings. Protoplasmic bases were not detected either. In the dorsal muscles of the frog, bushy simple endings predominate.

2214. Titova, L. K. 1956. THE DEVELOPMENT OF THE OLFACTORY ORGAN OF FISH AND AMPHIBIANS. (RAZVITIE ORGANA OBONYAINYA RYB I ZEMNOVODNYKH.) Doklady Akad. Nauk SSSR, Vol. 107, No. 5, pp. 749-751; Biol. Absts, Vol. 32, No. 10, Abst. No. 34149. 1958. (Translation)

In 3 species of sturgeon ("beluga", ("osetr"), "sevryuga") and 3 species of amphibians (green toad, lacustrine frog, and axolotl), the development of the olfactory organ was studied. In the hatching stage of fish, the division of cellular elements into the supporting and olfactory membrane, olfactoria interna, is clearly evident (the membrana olfactoria externa develops later). In the 3-day larva a difference is seen in the lining of the intermediate (receptor layer and central walls of the olfactory depressions. Earlier, central extensions of the olfactory cells emerge beyond the limits of the membrana olfactoria externa and form the olfactory nerve, which, on the 3rd-4th day after hatching, approaches the olfactory lobes and entwines their anterior part. In the receptor layer, fine histologic differentiation begins and by the 9th day all 3 types of olfactory cells are well-developed. In amphibians, the olfactory organ develops in an analogous way. The author concludes that in the lower vertebrates, just as in the higher ones, the cytologic differentiation of the olfactory organ becomes possible only after the fusion of the peripheral and central (olfactory sections) parts of the analyzer.

2215. Yamamoto, Tokio. 1957. ARTIFICAL INDUCTION OF REVERSAL IN SEX-DIFFERENTIATION OF THE MEDAKA, ORYZIAS LATIPES. (Japanese with English summ.) Japanese Jour. Genetics, Vol. 32, No. 11/12, pp. 333-346; Biol. Absts. Vol. 32, No. 10, Abst. No. 34172, 1958.

Present studies reveal the ambi-sexuality of the gonad primordium of the medaka and prove that gonad differentiation can be completely changed from the direction genetically determined to the opposite when heterotype hormones are administered throughout the period of indifferent gonad stage and are continued through the primary sex differentiation stage. That induced sex-reversals are fuctional is stressed. (G. Y.)

2216. Matsidaira, Chikayoshi, and Tsutomu Tsuda. 1957. STUDIES ON THE ANALYTICAL METHOD OF AMMONIA AND ORGANIC NITROGEN IN SEA WATER. Tohoku Jour. Agric. Res., Vol. 8, No. 1, pp. 37-45; Biol. Absts., Vol. 32, No. 11, Abst. No. 36262. 1958.

To 25 cc of material, 1 cc of .005 N NaBrO is added. A part of this is reduced by the $\overline{NH_3}$. An excess of KI and a measured amount of starch are then added; the remaining NaBrO drives the I out of KI; the amount of I is determined by the intensity of the resulting blue color, and the original concentration of NH_3 is calculated from this. The results are affected by presence of amino nitrogen, but not by nitrite. In determining organic N, the material is digested and neutralized as in the Kjeldahl method; these procedures are followed, not by distillation, but by determination of NH_3 as just described. (H. F. C.)

2217. Anonymous. 1958. SYMPOSIUM ON CHEMISTRY OF THE SEA. Jour. Chem. Educ., Vol. 35, No. 3, pp. 108-142; Biol. Absts., Vol. 32, No. 11, Abst. No. 36267, 1958.

This symposium treats (1) the history of oceanography; (2) chemical aspects of oceanography; (3) processes of regulating the composition of seawater including biochemical processes; (4) analytical chemistry in oceanography including the nutrition of marine organisms; (5) training in chemical oceanography. (G. O.)

2218. Bialkowsky, H. W., and P. S. Billington. 1957. PILOT STUDIES TO PREDICT EFFECTS OF WASTE ON RECEIVING WATERS. Sewage and Indust. Wastes, Vol. 29, No. 5, pp. 551-569. Biol. Absts., Vol. 32, No. 11, Abst. No. 36270, 1958.

Use of a dynamic model of a tidal estuary system for determining dilution factors available for discharge of pulp mill effluent from projected mills of varying size at several locations in the Chehalis River under conditions of variable fresh water runoff is detailed. Relative advantages of continuous and intermittent discharge were also investigated. Use of the model indicated that shifting the mill sewer discharge point from the river proper downstream into the bay would produce a 6- to 7-fold decrease in mill effluent concentration. (I. G.)

2219. Kutkuhn, Joseph H. 1958. THE PLANKTON OF NORTH TWIN LAKE, WITH PARTICULAR REFERENCE TO THE SUMMER OF 1955. Iowa State Coll. Jour. Sci., Vol. 32, No. 3, pp. 419-450. Biol. Absts., Vol. 32, No. 11, Abst. No. 36273. 1958.

Description of the physical characteristics of the lake, the general meteorological conditions and other background information are given. Samples were collected from 1951 to 1956 inclusive. Methods of collection and attendant shortcomings are discussed. Identification of phyto- and zooplankton indicated a rather broad representation from various groups of plants and animals. Among the phytoplankton were members of the Cyanophyta, Chloropyta, Chrysophyta; among the zooplankton were members of the Protozoa, Rotatoria, Arthropoda, Annelida, Nematoda and Bryozoa. Space does not permit the listing of species names, etc.. The change in population with changing conditions is noted. (G. H. N.)

2220. Scott, R. H., et. al. 1957. ORGANIZATION OF COOPERATIVE STATE-INDUSTRY STREAM STUDIES IN WISCONSIN. Sewage and Indust. Wastes, Vol. 29, No. 3, pp. 298-308. Biol. Absts., Vol. 32, No. 11, Abst. No. 36282. 1958.

Mechanics and objectives of cooperative stream sampling and analyses programs conducted by the pulp and paper industry and the Wisconsin Committee on Water Pollution are discussed. Procedures for cross-sectional sampling of streams are described in detail. Examples of sample data recording forms are presented. (I. G.)

2221. Wittenberg, Jonathan B. 1958. THE SECRETION OF INERT GAS INTO THE SWIM-BLADDER OF FISH. Jour. Gen. Physiol. Vol. 41, No. 4. pp. 783-804; Biol. Absts., Vol. 32, No. 11, Abst. No. 36993. 1958.

The composition of the gas mixture secreted into the swim-bladders of several species of fish has been determined in the mass spectrometer. The secreted gas differed greatly from the gas mixture breathed by the fish in the relative proportions of the chemically inert gases, argon, neon, helium, and nitrogen. Relative to nitrogen the proportion of the very soluble argon was increased and the proportions of the much less soluble neon and helium decreased. The composition of the secreted gas approaches the composition of the gas mixture dissolved in the tissue fluid. A theory of inert gas secretion is proposed. It is suggested that oxygen gas is actively secreted and evolved in the form of minute bubbles, that inert gases diffuse into these bubbles, and that the bubbles are passed into the swim-bladder carrying with them inert gases. Coupled to a preferential reabsorption of oxygen from the swim-bladder this mechanism can achieve high tensions of inert gas in the swim-bladder. The accumulation of nearly pure nitrogen in the swim-bladder of goldfish (Carassius auratus) is accomplished by the secretion of an oxygen-rich gas mixture followed by the reabsorption of oxygen. (Auth. abst.)

2222. Rosenthal, Harold L. 1958. COMPARATIVE UPTAKE OF CALCIUM-45 AND STRONTIUM-90 BY WILD AND LORDOTIC GUPPIES. Proc. Soc. Exptl. Biol. and Med., Vol. 97, No. 3, pp. 624-627; Biol. Absts., Vol. 32, No. 11, Abst. No. 37362, 1958.

The rate of uptake of Ca^{45} from the water in which they swim is greater for wild than lordotic guppies when the water contains 23 to 75 ppm Ca. When the water contains 275 ppm Ca, this difference is no longer apparent. The uptake of Sr^{90} is the same for both strains of fish and the uptake is not affected by the mineral content of the water. The incorporation of Ca^{45} by the spine is greater for the lordotic than the wild strain when Ca^{45} is taken up from tap water of low salt content, but the difference disappears when the water contains 275 ppm Ca. The incorporation of Sr^{90} by the spine for both strains is the same and is not affected by the mineral content of the water. These data indicate that the lordotic mutation in guppies is associated with a specific alteration in Ca metabolism. (Auth. abst.)

2223. Stolk, A. 1958. PATHOLOGICAL PARTHENOGENESIS IN VIVIPAROUS TOOTHCARPS. Nature, Vol. 181, No. 4624, p. 1660; Biol. Absts, Vol. 32, No. 11, Abst. No. 37566. 1958.

New cases reported in Lebistes reticulatus (Peters) and in Xiphophorus helleri Heckel in which the virginal animals bore female progeny. Upon examining the mother animals, the authors found a pathological process localized in the ovaries and surrounding area due to an infection with Ichthyophonus hoferi, a phycomycete. The assumption that the cause of parthenogenetic development in these cases is a pathological process seems to be justified.

2224. Devantoy, Jean. 1954. FISHES OF THE BELFORT REGION. (LES POISSONS DE LA RÉGION DE BELFORT.) Ann. Scient. Univ. Besancon. Zool. et Physiol., 1954, No. 2, pp. 17-33; Biol. Absts., Vol. 32, No. 11, Abst. No. 39104. 1958.

Annotated list of 35 spp. of freshwater fishes from canals, ponds, and streams of northeastern France. In addition to introduced American spp., others are assumed to have orginated from the Rhone and Rhine drainages. (R. W. P.)

2225. Morrow, James E. 1957. ON THE MORPHOLOGY OF THE PECTORAL GIRDLE IN THE GENUS MAKAIRA. Bull. Bingham Oceanogr. Coll., Vol. 16, No. 2, pp. 88-105. Biol. Absts., Vol. 32, No. 11, Abst. No. 39115. 1958.

The pectoral girdles of 2 Atlantic and 4 Pacific species of Makaira are described in and compared. The pectoral fin of M. m. marlina and M. m. tahitiensis is supported by a rigid 3 point suspension which prevents the fin from being folded. In the remaining 4 species, the articulation is such that the fin can be folded and rotated freely. The rigid pectoral fin is a valid diagnostic characteristic for M. m. marlina and M. m. tahitiensis, separating them from all forms with folding pectorals. Although M. a. mazara and M. a. ampla cannot be distinguished on the basis of external features, their pectoral girdles show such differences as to indicate that these forms are at least subspecifically distinct. The recent specific taxonomy of the 6 species is discussed briefly. (Auth. abst.)

2226. Morrow, James E. 1957. RACES OF THE STRIPED MARLIN, MAKAIRA MITSUKURII, IN THE PACIFIC. Bull. Bingham Oceanogr. Coll., Vol. 16, No. 2, pp. 72-87; Biol. Absts., Vol. 32, No. 11, Abst. No. 39114. 1958.

Statistical analysis of certain morphometric measurements and meristic characters have shown that striped marlin (M. mitsukurii) from Peru and from northern New Zealand represent separate populations. About 7 out of 10 in a mixed sample from the two localities can be properly assigned to their home area by the application of a character index. Evidence is presented which indicates that the pelvic fin stops growth after reaching a certain length is therefore not related to the length of the adult fish. (Auth. abst.)

2227. Muncy, R. Jess. 1957. FLATHEAD CATFISH. Iowa Conserv., Vol. 16, No. 5, pp. 129, 135; Biol. Absts., Vol. 32, No. 11, Abst. No. 39116. 1958.

In 2 years of trapping and electric-shocking a 7-mile stretch of the Des Moines River, Iowa, 239 flathead catfish (Pylodictis olivaris) were taken compared to 7447 channel catfish (Ictalurus punctatus). Presence of young and of several other ages indicate reproduction and residence in the area. Rings on pectoral spines indicated that 12-inch fish were 4 years old; 20-inch fish, 5-7 years; and 30-inch fish, 8-13 years. (K. D. C.)

2228. Pavlov, P. I. 1956. THE DANUBE REGION BREAM AS COMPARED TO THE DNIEPER BREAM. (PRIDUNAISKY LESHCH V SRAVNENII S DNEPROVSKIM.) Zool. Zhur., Vol. 35, No. 6, pp. 891-896; Biol. Absts., Vol. 32, No. 11, Abst. No. 39118, 1958. (Translation)

A comparison of meristic and plastic criteria, and also of certain biological characteristics of bream from the basins of the Danube and Dnieper, indicated that the Danube region bream is distinguished from Dnieper bream by the number of vertebrae: from a comparison of 24 plastic criteria, differences were established for 13. The Danube bream is also distinguished from the Dnieper bream by earlier onset of sexual maturity, and slower growth; it is related to the southern, geographically isolated form. --- Abramis bramo. danubii.

2229. Poll, Max. 1957. THE GENERA OF FRESHWATER FISHES OF AFRICA. (LES GENRES DE POISSONS D'EAU DOUCE DE L'AFRIQUE.) Ann. Mus. Congo Belge Tervuren, in-8°, Zool., Vol. 54, pp. 1-191; Biol. Absts., Vol. 32, No. 11, Abst. No. 39119. 1958.

The introduction explains the purposes and limitations of this work, which covers 233 genera in 38 families. A systematically arranged list is given. The general characters of each family are discussed, with notes on behavior and distribution and on the included genera. A special chapter deals with general geographical distribution of the ichthyological fauna of Africa, with map showing the different regions into which the continent is divided for this purpose, and another chapter deals particularly with the geographical distribution of fresh-water fishes of the Congo Basin. Explanation is given of the diagnostic characters used in the keys, followed by keys to families and genera of fresh-water fishes of Africa, with drawings of each genus. A bibliography of about 130 titles, index to illustrations, and index to scientific names is added.

2230. Anonymous. 1956. ON THE BIOLOGICAL INSTITUTE OF WATER RESERVOIRS. Vestnik Akad. Nauk SSSR, 1956, No. 11, pp. 105-106; Biol. Absts., Vol. 32, No. 12, Abst. No. 39204. 1958.

A report of the reorganization of the "Borok" Biological Station of the Scientific Institute and the water reservoir of the Biological Institute and on the strengthening of the staff of the laboratory of hydrology and hydrochemistry, microbiology, phytoplankton, phytobenthos and coastal plants, zooplankton and zoolbenthos, ichthyology, zoology and parasitology, and physiology of marine animals. The director of the Institute is I. D. Papanin.

2231. Bauchot, M. L., R. Bauchot, and P. Laubet. 1957. STUDY OF THE FISH FAUNA OF THE BASIN OF ARCACHON. (ÉTUDE DE LA FAUNE ICHTHYOLOGIQUE DU BASSIN D'ARCACHON (GIRONDE)). Bull. Mus. Natl. Hist. Nat., Vol. 29, No. 5, pp. 385-406; Biol. Absts., Vol. 32, No. 12, Abst. No. 39487. 1958.

From a detailed study, all fishes found are listed, together with notes on synonomy and ecology. Various zones and ecological communities are described. (C. G.)

2232. Huberty, Martin R. 1956. WATER RESOURCES OF THE WEST, TODAY AND TOMORROW. Proc. California Acad. Sci. IV, Vol. 28, No. 9,10,11,12, pp. 405-414; Biol. Absts., Vol. 32, No. 12, Abst. No. 39538. 1958.

The West, as herein defined, is represented by the 17 western states and includes all or parts of the following major drainage basins: North Pacific Coast, South Pacific Coast, Great Basin, Gulf of California, Gulf of Mexico, exclusive of Mississippi River, and parts of the Western Mississippi River, and the Hudson Bay drainage basins. Included is a "selected list of literature on the water resources of western U. S. and their development."

2233. LeGrand, Yves. 1957. THE ELECTRICITY OF THE OCEANS. (L'ÉLÉCTRICITÉ OCÉANIQUE) Scientia (Milan), Vol. 92, No. 10, pp. 249-254; Biol. Absts., Vol. 32, No. 12, Abst. No. 39539. 1958.

The problems related to the electric currents and to the differences of potential in the sea have been investigated only infrequently up to the present. A review of the known causes of these phenomena is given. By measuring the surface potentials in the sea, it is possible to get some information on the upper water-masses. (M. M.)

2234. Skerman, T. M. 1958. SEASONAL VARIATIONS IN SEA-WATER SURFACE TEMPERATURES WITHIN NEW ZEALAND HARBOURS. New Zealand Jour. Geol. and Geophys., Vol. 1, No. 1, pp. 197-218; Biol. Absts., Vol. 32, No. 12, Abst. No. 39547. 1958.

Surface temperature records for the harbors of Auckland, Wellington, Lyttelton, Timaru, Otago, and Bluff have been compiled from observations taken from 1952 to 1955. For certain of these years mean, highest, and lowest recordings for 6-day periods are presented to indicate in some detail the nature of seasonal trends. Monthly means, summer-winter extreme and mean ranges are also tabulated Diurnal, and abrupt temperature variations in Wellington Harbor are demonstrated and their causes examined. A tidal oscillation in the summer daily temperature anomalies is shown for Portobello (Otago). Seasonal differences between harbor and offshore temperatures at Lyttelton and Otago are outlined. Some ecological implications of widely fluctuating temperatures within harbor waters are

discussed. A bibliography of published temperature data for New Zealand ports and harbors is appended. (Auth. summ.)

2235. Smirnova, L. I. 1956. THE PHYTOPLANKTON OF THE NORTHWEST PART OF THE PACIFIC OCEAN. (O FITOPLANKTONE SEVERO-ZAPADNOI CHASTI TIKHOGO OKEANA.) Doklady Akad. Nauk SSSR, Vol. 109, No. 3, pp. 649-652; Biol. Absts., Vol. 32, No. 12, Abst. No. 39548. 1958. (Translation)

In the collection of the Institute of Oceanology of the Academy of Sciences of the USSR for August-October, 1954, data are given regarding the phytoplankton of the northwest part of the Pacific Ocean. That part of the ocean under the influence of the warm (Japan) current and of the cold (Oyashio) current was covered. A total of 131 species of algae were observed. The warm-water complex had the greatest variety: 55 species; the moderately warm water, 19 species; the moderately cold water, 27; the cold water, 10; the remaining 20 species have a wide ecological range. The warm-water forms are associated predominantly with the area to the south of 42° north latitude, and this is the limit of distribution of some cold-water species.

2236. Vinberg, G. G., T. N. Godnev, and V. I. Gaponenko. 1955. THE EXPERIMENTAL USE OF RADIOACTIVE PHOSPHORUS IN THE STUDY OF POND FERTILIZATION. (OPYT PRIMENENIYA RADIOIZOTOPA FOSFORA PRI IZUCHENII UDOBRENIYA PRODOV.) Doklady Akad. Nauk SSSR, Vol. 100, No. 3, pp. 575-578; Biol. Absts., Vol. 32, No. 12, Abst. No. 39567. 1958. (Translation)

Superphosphate plus an additional 23 microcuries of P^{32}, was introduced into 2 out of 5 experimental ponds (with an area of 0.08-0.1 hectare and an average depth of 0.5-0.6m). For the first 5 days after the introduction of P^{32}, the total activity of the water decreased at an approximately constant relative rate, which was practically identical in the 2 ponds (15.7 and 17.2% in 24 hours). During the following days, the activity of the pond water was higher than would have been expected if the same rate of decrease had been maintained, which can be explained by the effect of the reexcretion of metabolized P^{32} back into the water. Chemical analyses showed that the total P content of the pond water increased rapidly after the introduction of superphosphate, reaching a maximum in 7-10 days. The concentration of mineral P, which initially accounted for a small percentage of the content of this element, increased more slowly.

2237. Protasov, A. A. 1955. THE ROLE OF DWARF MALES IN THE ARTIFICIAL PROPAGATION OF KURA RIVER SALMON. (ROL KARLIKOVYKH SAMTSOV PRI PROMYSHLENNOM RAZVEDENII KURINSKOGO LOSOSYA.) Voprosy Ikhtiol., 1955, No. 5, pp. 48-52; Biol. Absts., Vol. 32, No. 12, Abst. No. 39595. 1958. (Translation)

In artificial breeding and raising of the young of the Kura river salmon at the Chaikend Fish Hatchery within 21 months from the beginning there were produced: (1) females having oocytes in a period of small growth; (2) males 11 to 14 cm long, weighing 11.5 to 39g, with testes in the very 1st stage of development weighing 10 to 20 mg with a coefficient of maturity of 0.09 to 0.1%; (3) dwarf males of the same size but with almost flowing milt (the gonad weight 200 to 1800 mg) with a coefficient of maturity of 0.9 to 6.4% (the average 3%), which was close to the coefficient of maturity of full-sized milting salmon. Of the total number of young, there were 30% dwarf males which can be used as supplementary producing males at fish hatcheries.

2238. Blazka, P. 1958. THE ANAEROBIC METABOLISM OF FISH. Physiol. Zool., Vol. 31, No. 2, pp. 117-128; Biol. Absts., Vol. 32, No. 12, Abst. No. 39851. 1958.

A flow apparatus for studying the gaseous exchange of water animals is described. At low temperatures (5°C) crucian carps (Carassius carassius) tolerate anoxia for at least 2 months. At higher temperatures (16°C) they tolerate it for several hours only. Hydrogen sulfide poisoning does not complicate the influence of simple anoxia. Sulfide quickly penetrates into the tissues of poisoned fish, and it is washed out when the fish come into sulfide-free water. Blood circulation probably continues. The critical tension (i.e., the lowest concentration of O_2 which does not lower the O_2 consumption of the animal) of carps is about 1.7 ml O_2/l at 5°C. Crucian carps do not repay the O_2 debt; trout (Salmo trutta m. fario) do. Lactic acid is not accumulated in either species. Lower fatty acids are accumulated by the trout. The only acid compound excreted by anoxic carp is CO_2. Fat was accumulated by crucian carp during a winter spent in anoxic conditions. A theory of anaerobic metabolism of fish based upon these findings is given. (Auth. abst.)

2239. Pillay, T. V. R. 1958. MORPHOLOGICAL AND PHYSIOLOGICAL CHARACTERS OF THE BLOOD OF HILSA, HILSA ILISHA (HAMILTON) OF THE RIVER HOOGHLY. Proc. Indian Acad. Sci. Sect. B., Vol. 47, No. 3, pp. 155-162; Biol. Absts., Vol. 32, No. 12, Abst. No. 40289. 1958.

The erythrocyte counts, hemoglobin content, coagulation period and cell and nuclei size of the blood of Hilsa from the river Hooghly have been determined. Using the Climbing Perch as test material, it has been shown that the characteristics of the blood taken from the heart of live fish are not significantly different from those of dead fish which have been preserved in ice immediately after capture. The mean erythrocyte count of Hilsa is much higher than that of many other species of fish and this appears to be correlated with the relatively small size of the cells. The coefficients of variation of the different characters are below 20%, which may be considered as the normal variation in the Hilsa of the Hooghly for purposes of comparison with blood samples of other stocks of Hilsa. (Auth. summ.)

2240. Jones, F. R. Harden, and G. Pearce. 1958.

ACOUSTIC REFLECTION EXPERIMENTS WITH PERCH (PERCA FLUVIATILIS LINN.) TO DETERMINE THE PROPORTION OF THE ECHO RETURNED BY THE SWIMBLADDER. Jour. Exptl. Biol., Vol. 35, No. 2, pp. 437-450; Biol. Absts., Vol. 32, No. 12, Abst. No. 40524, 1958.

The experiments were carried out in an indoor freshwater tank 6 m long, 3 m wide and 3 m deep at a frequency of 30 Kc/second. Freshly killed 20-cm perch were suspended in the tank and rotated about their longitudinal and vertical axes, measurements being made of the amplitude of the received signal when the swimbladder was full, after it had been emptied and when a false "Onazote" swimbladder was substituted for the real one. The results showed that the amplitude of the echo fell by 50% when the swimbladder was emptied and that the polar diagram of the fish with its natural swimbaldder is similar in shape to that obtained with a false "Onazote" swimbladder. (Authors)

2241. Lissmann, H. W., and K. E. Machin. 1958. THE MECHANISM OF OBJECT LOCATION IN GYMNARCHUS NILOTICUS AND SIMILAR FISH. Jour. Exptl. Biol., Vol. 35, No. 2, pp. 451-486. Biol. Absts., Vol. 32, No. 12, Abst. No. 40529. 1958.

There are several possible mechanisms whereby electric fish can locate objects. It appears from the results of a long series of training experiments that Gymnarchus niloticus detects objects by the disturbance they cause in their own electric field in the water. A theoretical analysis of this mechanism indicates that the effect of an object on the electric receptors of the fish depends on the detailed electrical properties of the receptors. In the extreme cases, the stimulation is proportional either to potential around the fish or to its second derivative. Calculations have been made of the effect which an object produces on the receptors in these two extreme cases; the results are presented graphically. In Gymnarchus it appears probable that the receptors operate in the "second derivative mode". The limits of sensitivity of the fish have been determined experimentally; conclusions about the properties of the sensory system follow from these results. Experiments with moving electrostatic and magnetic fields indicate that Gymnarchus is sensitive to a potential gradient of about 0.03 μ V/cm; the same set of receptors is probably responsible for this high sensitivity. (Authors)

2242. Malyukina, G. A. 1955. RESULTS OF THE STUDY OF THE PHYSIOLOGY OF THE ANALYZORS OF THE LATERAL LINE OF FISH BY CONDITIONED REFLEX METHODS. (REZUL'TATY IZUCHENIYA FIZIOLOGII ANALIZATORA BOKOVOI LINII RYB METODOM USLOVNYKH REFLEKSOV). Zhur. Vyssh. Nervn. Deyatelnosti, Vol. 5, No. 3, pp. 426-429; Biol. Absts., Vol. 32, No. 12, Abst. No. 40610. 1958. (Translation)

In fish with motor-food conditioned reflexes to a series of auditory and all diapasons of infraauditory frequencies of fluctuations of the watery environment, denervation of the lateral line organ with intact hearing organs does not impair the above reflexes at frequencies above 18 Hertz, whereas removal of the sacculus and lagena of the labyrinth with intact lateral line causes these reflexes to disappear at frequencies above 25 Hertz. Adequate vibration for the analysor of the lateral line of fish is from 1 to 25 Hertz, for the auditory analysor it is 18 Hertz and higher. The analysor of the lateral line allows the differentiation of frequencies of a 3-Hertz difference.

2243. Thomas, J. D. 1958. STUDIES ON THE STRUCTURE, LIFE HISTORY AND ECOLOGY OF THE TREMATODE PHYLLODISTOMUM SIMILE NYBELIN, 1926 (GORGODERIDAE:GORGODERINAE) FROM THE URINARY BLADDER OF BROWN TROUT, SALMO TRUTTA L. Proc. Zool. Soc. London, Vol. 130, No. 3, pp. 397-435; Biol. Absts., Vol. 32, No. 12, Abst. No. 42265. 1958.

Brown trout (Salmo trutta), salmon parr (Salmo salar) and the eels (Anguilla anguilla) from certain rivers in West Wales were examined over a period of nearly two years for parasites. Large numbers of Phyllodistomum simile were found in the urinary bladder of the trout from the River Teify. P. simile was not found in any of the 274 salmon parr or 243 eels examined, probably due to an ecological immunity in the former and a physiological immunity in the latter. There was no evidence of a seasonal variation in the occurrence of P. simile in trout aged two years or more. Trout aged four or more years were more heavily infested than young trout and there was no indication of the development of a total immunity with increase in the age of fishes. The life history of P. simile was elucidated under experimental conditions by feeding the trout precocious metacercariae present in daughter sporocysts obtained from the gill lamellae and epibranchial cavity of the freshwater bivalve, Sphaerium corneum. The anatomy of the daughter sporocyst, the cercaria, metacercaria and the adult stages are described. The gorgoderid cercariae and the attempts to classify them into groups corresponding to those of the adults are discussed. It is suggested that attempts at discussing the evolution of the cercariae placed in the family Gorgoderidae may be premature in view of the fact that life histories have only been elucidated experimentally for cercariae of the macrocercous, cystocercous kind. The advantages in the life cycle of precocious encystment within the sporocyst are commented upon but it is also suggested that P. simile may have a second intermediate host, possibly the minnow, Phoxinus phoxinus or a freshwater arthropod. The morphological changes that take place during the development of P. simile and their importance in specific diagnosis are discussed. It is suggested that in view of the more readily discernable differences between the larvae certain larval features might well be used in distinguishing species of doubtful validity. (Auth. summ.)

2244. Anderson, William D., and Harry W. Freeman. 1957. FISHES OF THE CONGAREE

RIVER DRAINAGE, SOUTH CAROLINA. Univ. S. Carolina Publ. Ser. III. Biol., Vol. 2, No. 2, pp. 90-111; Biol. Absts., Vol. 32, No. 12, Abst. No. 42496. 1958.

The specimens collected represent 18 families, 36 genera, and 52 species. The scientific name and at least one common name, where known, of each species are given. This is followed by station numbers. Following this whenever the species has been previously reported from the Congaree River drainage area the source of information and the county are mentioned. In some cases the species has been reported from other portions of the Santee Basin which are very close to the Congaree River drainage area. References for identification and distribution are given.

2245. Davies, D. H. 1957. THE BIOLOGY OF THE SOUTH AFRICAN PILCHARD, (SARDINOPS OCELLATA). Union S. Africa Dept. Commerce and Indust. Div. Fish. Invest. Rept., Vol. 32, pp. 1-11; Biol. Absts., Vol. 32, No. 12, Abst. No. 42500. 1958.

The report discusses taxonomy and description, distribution, associated species, reproduction, size, growth and age, feed, migration, disease, predators and commercial importance of S. ocellata.

2246. Hikida, Toyohiko. 1957. A PRELIMINARY LIST OF FISHES FROM NORTH PACIFIC OCEAN. Jour. Fac. Sci. Hokkaido Univ. Ser. VI. Zool., Vol. 13, No. 1/4, pp. 46-48; Biol. Absts., Vol. 32, No. 12, Abst. No. 42503. 1958.

A lamprey, and 3 cartilaginous and 15 bony fishes are listed. (Y. W.)

2247. Burgner, Robert Louis. 1958. A STUDY OF FLUCTUATIONS IN ABUNDANCE, GROWTH, AND SURVIVAL IN THE EARLY LIFE STAGES OF THE RED SALMON (ONCORHYNCHUS NERKA WALBAUM) OF THE WOOD RIVER LAKES, BRISTOL BAY, ALASKA. Dissertation Abstracts, Vol. XIX, No. 4, p. 911.

The young red salmon (Oncorhynchus nerka) of the Wood River Lakes, Bristol Bay, Alaska, were studied to determine fluctuations in abundance, growth, and survival, and to ascertain causes of these fluctuations.

Indices of seasonal and annual variation in numbers of young salmon migrating seaward were obtained by fishing fyke nets at the outlet of the lake system. Sampling systems to determine changes in age and growth of these seaward migrants were developed, including a method whereby the majority of fish sampled were measured alive and released. Diurnal changes in size of smolts migrating were found.

The relationship between magnitudes of parent escapement of red salmon in the Wood River Lakes and of seaward migrants produced was found to be highly variable for the year classes 1949 through 1955. Sources of variability in growth and survival were therefore sought. The amount of growth attained by yearling smolts during the early part of the growing season and the timing of the seasonal migration were related to timing of breakup of lake ice and temperatures following breakup. The scales of seaward migrants and of returning adults were utilized to show that size at seaward migration varies with lake of origin. Differences between years and between lake areas in growth attained during the first year of life are associated with differences in lake population density.

Size of yearlings at the time of seaward migration is shown to influence marine survival and/or age at return.

Methods of determining abundance of free-swimming young red salmon at intermediate life stages within the lakes were investigated as a first step toward ascertaining more precisely the time, place, and causes of variability in freshwater survival. Specially designed floating lake traps were fished each summer over a period of several years. Catches of red salmon fry (age 0) were highest during June and early July, following lake-ice breakup. Changes in seasonal catch pattern were partially explained by observed seasonal differences in fry development, distribution, and behavior. The seasonal changes in catch pattern of red salmon fry and threespine sticklebacks were compared. Environmental changes influencing both red fry and sticklebacks create seasonal variability in availability of these species to inshore gear.

In order to determine the significance of the differences between years in level of fry catch in inshore lake traps, independent methods of measuring abundance were introduced in 1957. Trials of the floating lake traps set in offshore positions suggest that fluctuations in red fry catch may be less severe than in inshore trap locations, and that offshore catches will persist later in the season, both of which are desirable features for abundance indexing. However, magnitude of catch of the traps in offshore locations was low.

Sampling by means of a ten-foot diameter net towed between two outboard boats was tried and proved successful in capturing young red salmon and threespine sticklebacks in sufficient numbers to give promise as a means of indexing abundance. Tows at or very near the surface were successful; deeper tows failed to capture fish in numbers. It was demonstrated that in mid-summer the zooplankton on which the young salmon feed are abundant near the surface for only a short period each day, during hours of reduced light, but that concentrations at that time are dense, favoring fish feeding near the surface at night. Red fry were found to be virtually absent in offshore tow-net hauls in June and July, but were captured consistently in August and September. The distribution of red fry may prove sufficiently uniform in late summer to make indexing of their abundance of tow net feasible.

2248. Menzel, David Washington. 1958. UTILIZATION OF FOOD BY THE REEF FISHES HOLACANTHUS BERMUDENSIS AND EPINEPHELUS GUTTATUS. Dissertation Abstracts, Vol. XIX, No. 4, p. 915.

The purpose of this study is to compare the relative efficiency with which two species of Bermuda reef fishes utilize their food for growth. In order to evaluate the importance of plant matter in its diet the angelfish, Holacanthus bermudensis, an omnivore, was fed algae. To determine how initial size and temperature change influence its growth the red hind, Epinephelus guttatus, a carnivore, was fed a diet of fish.

Three size groups of the angelfish and red hind were captured on the Bermuda reefs, and retained in experimental feeding tanks for 21-day periods. Feeding experiments were conducted at three temperatures which approximate the extreme (19° C. and 28°C.), and the median (23°C.) annual water temperatures in Bermuda.

Prior to each experiment a series of control fish was analyzed for water, fat, and protein content. Experimental fish were also analyzed and the deposition of organic constituents was measured. Daily collection of feces made it possible to estimate the amount of food that was absorbed from the intestine.

Feeding rates of the angelfish were influenced by temperature. Large (200 to 300 gram) and medium-sized (100 to 200 gram) fish ingested twice as much at 28° C. as at 19° C.; small fish (50 to 100 gram) ate 3.5 times more (a rate of 8.1 percent of the body weight per day). The effectiveness with which fractions of the algae were absorbed from the intestine ranged from 82 to 91 percent for nitrogen, and 63 to 79 percent for total carbohydrates.

Growth was not achieved by the angelfish at any temperature, although sufficient energy was ingested for maintenance. Lack of growth is attributed to the low nitrogen content of the algal diet. The ability of fish to maintain weight was dependent on the attainment of energy balance. The deposition of fat occurred on energy intake in excess of metabolic requirements, whereas fat was depleted when the energy balance was negative. In a few instances sufficient nitrogen was ingested to prevent the breakdown of body proteins, but in general negative nitrogen balance resulted. The rate of endogenous nitrogen excretion was calculated at 7.5 mgm/kcal./day.

Red hinds grew significantly at all temperatures. Both the rates of growth and relative feeding increased markedly between 23° C. and 28° C., but not between 19° C. and 23° C. Small fish (130 to 240 gram) ate relatively more, and grew relatively faster, than fish of the two larger sizes (300 to 450 grams and 500 to 700 grams). The growth rates and feeding rates of the two larger sizes of fish were comparable at all temperatures.

The efficiency with which proteins were utilized for growth was highest among small, and equal among the two larger sizes of fish. It did not vary with temperature. The rate of fat deposition was inversely related to the size of fish; the smaller the fish the greater was the deposit per unit intake. Relatively more fat was synthesized at 28° C. than at 23° C. or 19° C. Proteins were converted to fat at 28° C.

The number of calories retained per unit caloric intake decreased with increase in the size of fish; this ratio was not influenced by temperature. No correlation was found between the relation of weight gain to weight of food and the utilization of energy.

A major conclusion to be drawn from this study is that angelfish cannot grow on plant matter alone, although their natural diet consists largely of vegetation. From this it is possible to surmise that herbivorous fishes in general probably cannot grow on naturally occurring plant matter alone unless: (1) they feed at a rate in excess of 8 percent of their body weight per day; and (2) they do not select individual algae with a high nitrogen content. The growth rates of red hinds, at least between 19° C. and 28° C., are influenced directly by the amount of food consumed. Temperature changes influence growth only as they influence feeding rates.

2249. Harmic, Jay L. 1958. SOME ASPECTS OF THE DEVELOPMENT AND THE ECOLOGY OF THE PELAGIC PHASE OF THE GRAY SQUETEAGUE, CYNOSCION REGALIS (BLOCH AND SCHNEIDER) IN THE DELAWARE ESTUARY. Dissertation Abstracts, Vol. XIX, No. 5, p. 1142.

Collections of eggs and larvae were made at various stations and at different depths in the Delaware River estuary during the spawning seasons of 1955, 1956, and 1957. Analysis of the collections indicated that the gray squeteague, Cynoscion regalis (Bloch and Schneider), utilized most of the bay for spawning as eggs of this species were found in collections from the mouth of the bay to the Smyrna River. The greatest spawning activity, based on the number of eggs found, was the southwestern part of the estuary. The spawning season of the gray squeteague was found to extend from late May until early August with the principal production of eggs in the latter part of June and the latter part of July. Eggs and larvae were found in waters with temperatures ranging from 17.0° to 26.5° C. and in water of salinities from 12.05 to 31.13 parts per thousand. Identification and aging of eggs during development were based on a reference collection prepared as a part of this study. By means of this collection the morphometric and embryological characteristics of the gray squeteague egg were described and various measurements were recorded from the eggs and the newly hatched larvae.

Laboratory propagation experiments were carried out to determine the upper and lower limits of survival for temperature and salinity. Gray squeteague eggs hatched after approximately 1,000 degree-hours in the laboratory experiments. Some hatching occurred in waters with salinity values ranging from 12.00 to 32.50 parts per thousand and temperatures ranging from 12.0° to 31.5° C. Optimum hatching took place between 18° and 24° C. Laboratory experiments employing sudden temperature and salinity changes of the magnitude encountered in the Delaware River estuary were found to be capable of drastically reducing the percentage of eggs hatching.

Mechanical injury and subsequent failure of the eggs to hatch as a result of turbulence produced experimentally demonstrated the possibilities of mass mortality of eggs and larvae in the estuary as a result

of storms. Deficiencies of dissolved oxygen lowered the success of hatching. The addition of a mixture of 25 parts per million each of penicillin and streptomycin to the water in which the eggs were developing increased the success of hatching approximately four times. Seventy-five parts per million of either of these used alone was toxic. No difference in hatching success was obtained when eggs were propagated in constant darkness or constant light.

The ranges of salinity and temperature found in the laboratory suggest reasons for the distribution of spawning in the estuary. Most of this activity and subsequent development of eggs in the estuary falls within the ranges found to be optimum in the laboratory experimental work. This study concludes that the gray squeteague definitely spawns in the estuary. Because of the rapid rate of development the eggs collected in the bay could not have been carried in on tidal currents before hatching occurred. Collections in the tributary rivers indicated that no spawning took place there and that eggs were not being washed in from the tidal streams. The frequent variations in salinity or temperature, or the occasional extreme turbulent conditions that occur within the Delaware River estuary could have a distinct effect on the success of a year class of the gray squeteague. This may be an explanation for the fluctuating character of the fishery and the information may be useful in the future management of the gray squeteague in the Delaware River estuary.

2250. Stross, Raymond George. 1958. EXPERIMENTALLY INDUCED CHANGES IN LAKES. A) ENVIRONMENTAL CHANGES FOLLOWING LIME-APPLICATION TO STAINED LAKES. B) CHANGES IN THE PLANKTONIC CRUSTACEA FOLLOWING THE INTRODUCTION OF TROUT TO A FISH-FREE LAKE. Dissertation Abstracts. Vol. XIX, No. 5, p. 1147.

Small bog lakes appear to offer comparatively simple and stable ecosystems for the study of environmental alterations. The object of one study was to ascertain certain effects from adding hydrated lime to one portion of an artifically divided hour-glass-shaped lake. The other part served as a control from which alterations of certain physical, chemical, and biological conditions in the treated portion were evaluated. In the second study the planktonic Crustacea, particularly the Daphnia population, served as a bioassay for determining the effect of substituting trout for insects as predators.

Following the addition of hydrated lime nearly 100 percent solubility was achieved through adequate dispersal of the particles of lime, for which a method is described, and by limiting the application to slightly more than can be transformed immediately to bicarbonate.

Lime-treatment increased the depth to which light penetrated in the treated portion reaching a maximum of 100 percent after three years. In two other lakes treatment produced increases of 25 to 40 percent within three weeks.

In comparatively small lakes the clarity of the water is of decisive importance in determining the thickness of the epilimnion. This was demonstrated in the experimental lake and in 11 others in northeastern Wisconsin and Upper Michigan; the lakes vary in size from 0.3 to 75 acres, and in transparency from 1.0 to 18.0 meters. With two exceptions the thickness of the epilimnion is 0.5 to 0.6 the value of transparency. A doubling of this layer in the treated portion, over that of the control, resulted in a 21 to 23 percent increase in the annual heat budget.

Calcium, magnesium, and bicarbonate were measured to determine the efficiency of each application of lime. Although a calculated 70 percent of the iron was removed from the lime-treated portion, the iron which remained was effective in removing phosphorus from the trophogenic layer. The small supplementary additions of lime were insufficient to increase the level of phosphorus in the lake.

The average annual standing crops of planktonic crustacea were much more consistent in the control than those in the treated portion. A part of the variability was attributed to the discontinuation of lime-treatment. Among the changes in species-composition Daphnia longispina replaced Daphnia pulex in the treated portion; D. longispina continued to be predominant in the treated portion, while D. pulex dominated the control.

The growth-form of the two populations of Daphnia was described for a 96-day period from daily changes in three embryonic and three postnatal size-age categories. Calculations of mortality in the population for the 96 days were based on the concomitant changes in these categories during each computed interval corresponding to the sojourn of embryos in the brood pouch. Values of mortality were then used to calculate turnover-times for the two populations; they were 2.1 weeks for D. longispina and 5.7 weeks for D. pulex,

The percentage of embryos in the Daphnia populations was suggested to be proportional to the rate of turnover. It was shown that the reproductive intensity of Daphnia, as measured by the percentage of embryos, was inversely related to the average standing population of Daphnia for each of the three years. However in another untreated bog lake in which other species of Crustacea were predominant the reproductive intensity was inversely proportional only to the entire standing population of planktonic Crustacea.

Part II showed the vertical redistribution of a population of D. pulex in a naturally occurring fish-free lake when small rainbow trout were substituted for insects which preyed upon the planktonic Crustacea. Prior to treatment, nymphal notonectids and larval dytiscids occupied the upper 2-meter stratum, and the Daphnia were distributed below this region. After the trout eliminated the insects from this zone, the Daphnia assumed a normal vertical distribution, the average seasonal abundance doubled, but the average dry weight of the planktonic Crustacea indicated that no change in standing crop occurred as a result of the substitution of predators.

2251. Alderdice, D. F., and W. P. Wickett. 1958. A NOTE ON THE RESPONSE OF DEVELOPING CHUM SALMON EGGS TO FREE CARBON DIOXIDE IN SOLUTION. Journal of the Fisheries Research Board of Canada, Vol. 15, No. 5, pp. 797-799.

The ability of early incubation stage eggs to utilize dissolved oxygen was found to be independent of CO_2 below a CO_2 level of 125 ppm. Mortality under high CO_2 levels apparently is a function of the inhibition of oxygen uptake by the CO_2, resulting in a decelaration of metabolic rate which ultimately is lethal if prolonged. Pre-circulatory salmon eggs may respond in the same manner to high CO_2 levels and low dissolved oxygen levels.

2252. Brett, J. R., and D. F. Alderdice. 1958. THE RESISTANCE OF CULTURED YOUNG CHUM AND SOCKEYE SALMON TO TEMPERATURES BELOW 0°C. Journal of Fisheries Research Board of Canada. Vol. 15, No. 5, pp. 805-813.

Recent efforts to establish Pacific salmon in Hudson Bay posed the question of low temperature tolerance in these species. A series of lethal temperature tests at - 0.5, -1.0 and -1.5° C. demonstrated that resistance to temperatures slightly below 0°C. was limited. Freezing of the blood and aqueous humour occurred at temperatures of -1.0 and -1.5°C. (Auths. abst.)

2253. Brett, J. R., and M. A. Ali. 1958. SOME OBSERVATIONS ON THE STRUCTURE AND PHOTOMECHANICAL RESPONSES OF THE PACIFIC SALMON RETINA. Journal of the Fisheries Research Board of Canada. Vol. 15, No. 5, pp. 815-829.

The general structure of the Pacific salmon retina is described. Rods, single cones and twin cones constitute the visual cell layer which, together with the dense pigment layer, undergoes photomechanical changes common to most teleosts. Stages in the contraction and expansion of rods and cones, and the migration of pigments are depicted.

In the laboratory, cultured sockeye salmon became well light-adapted in 20-25 minutes, whereas the time for dark-adaptation was of the order of 55-60 minutes.

In the Lakelse River, a sample of natural-run sockeye and coho smolts was found to be fully dark-adapted by about 10:00 P. M. when the light intensity at the water surface was 0.03 foot-candle. Pink and chum fry from Hooknose Creek were similarly dark-adapted by about 9:45 P. M. on an evening when the intensity had fallen below 0.002 ft.-c. At the start of evening migration retinal dark-adaptation in sockeye smolts had just started, whereas in pink and chum fry the retina was approximately half dark-adapted when migration commenced. (Auths. abst.)

2254. Dodimead, A. J., and H. J. Hollister. 1958. PROGRESS REPORT OF DRIFT BOTTLE RELEASES IN THE NORTHEAST PACIFIC OCEAN. Journal of the Fisheries Research Board of Canada. Vol. 15, No. 5, pp. 851-865.

Twenty-five thousand drift bottles have been released in lots of one thousand at Ocean Weather Station PAPA and at eleven selected positions in the northeast Pacific Ocean. To April 15, 1958, there have been 816 returns.

The principal characteristics of the surface movement, as shown by the drift bottle paths, are in agreement with the geopotential topography, allowing for a component of movement generally to the right across the isobars. The drift bottle results substantiate the seasonal changes in surface movement implied by the geopotential topography. They also show the changes that occur between the periods of the oceanographic surveys.

Frequency distribution curves, used to determine the "most probable time at sea" of the drift bottles were similar for all releases.

The "most probable speeds" varied between 3 and 9 miles per day and are comparable to average speeds calculated from the geopotential topography. (Auths. abst.)

2255. Foskett, D. R. 1958. THE RIVERS INLET SOCKEYE SALMON. Journal of the Fisheries Research Board of Canada. Vol. 15, No. 5, pp. 867-889.

The Rivers Inlet sockeye catch has average about 1 million fish per year, over 45 years. These are from smolts produced in a cold, deep lake, only 30 square miles in extent, and most of it heavily silted by glacial tributaries. The water has only a moderate lime content and its reaction is neutral or very slightly acid. The lake's plankton crops are small, though blooms of bluegreen algae occur in autumn in the clear uppermost basins, following on the death of large numbers of spawning sockeye. Smolts are unusually small in size, averaging about 2 grams when sampled in 1914-16 and again in 1954; almost all are age 1. The commercial gill-net fishery harvests most efficiently the salmon of intermediate sizes: the medium and large age 4 fish, and the medium and small age 5 fish. Hence escapement tends to consist of extremes of size, the larger age 5's, smaller age 4's, and almost all the age 3's. Sockeye spawning takes place in many inlet streams, along parts of the lake shore, and in the outlet river. The spawners in the various tributaries differ considerably in respect to the age structure of their runs, and to some extent in size at a given age, though the selective fishery may account for some part of these differences. Conditions for spawning and incubation in the region are still practically in their natural state.

The most important management problem is to determine whether increasing the fry output into the lake would increase or decrease production of adult sockeye: the smolts are now so small that any larger numbers might possibly reduce their size below some critical level. Next in importance is to determine whether or not the present numbers of spawners are necessary to fertilize the lake for the growth of the young, and if so, whether a less valuable fertilizer might be substituted. (Auth. abst.)

2256. Godfrey, H. 1958. COMPARISONS OF THE INDEX OF RETURN FOR SEVERAL STOCKS OF BRITISH COLUMBIA SALMON TO STUDY VARI-

ATIONS IN SURVIVAL. Journal of the Fisheries Research Board of Canada, Vol. 15, No. 5, pp. 891-908.

The "index of return" (ratio of offspring catch to parent catch) was used to compare annual survival among several stocks of British Columbia salmon. Over a period of almost 30 years the major stocks of pink salmon in the Province, excepting those of the Fraser River, exhibited quite similar annual variations in survival. The Fraser River stock behaved somewhat independently of the other stocks. There are indications that among pink salmon early ocean survival, probably during residence in estuarial and inshore waters, has played a major role in determining the level of final ocean survival. Among pink and sockeye salmon that entered the sea in the same year there is some similarity in early ocean survival. The latter relationship, if confirmed, may become useful for predicting sockeye ocean survival one or two years before the adult fish return. (Auth. abst.)

2257. Hourston, Alan S. 1958. POPULATION STUDIES ON JUVENILE HERRING IN BARKLEY SOUND, BRITISH COLUMBIA. Journal of the Fisheries Research Board of Canada. Vol. 15, No. 5, pp. 909-960.

Population studies were carried out on herring in the juvenile (first year, post-metamorphosis) stage in Barkley Sound in the summers of 1951 to 1954. Their chief objective was to detect and estimate yearly changes in relative abundance. The juveniles were found mostly in shallow, sheltered bays, inlets and channels, mainly on the southeast side of the sound. The stocks apparently arose from different mixtures of the progeny of a series of spawnings extending over two months and located mainly on the northwest side of the sound. Mixing between localities averaged less than one-third. The 1953 and 1954 juvenile populations were above average (both about 640 million fish), while the 1952 population was below average. Upon recruitment to the fishery, the relative strength of these three year-classes was comparable to that observed in the juvenile stage. Thus, surveys of herring abundance at the juvenile stage provide an index of year-class strength at recruitment. (Auth. abst.)

2258. Johnson, W. E. 1958. DENSITY AND DISTRIBUTION OF YOUNG SOCKEYE SALMON (ONCORHYNCHUS NERKA) THROUGHOUT A MULTI-BASIN LAKE SYSTEM. Journal of the Fisheries Research Board of Canada, Vol. 15, No. 5, pp. 961-982.

Estimates of density (based on catch per unit effort with tow nets) of fingerling sockeye salmon populations in a large (174 sq. mile) multibasin lake system were carried out during 1955, 1956 and 1957. Density and distribution of fingerling sockeye throughout the lake system are related to density and distribution of the spawning parent populations. Discrete populations associated with discrete basins point to a limited dispersal as a result of the multibasin nature of the lake system. In one example, higher population density appears to result in greater dispersal. (Auth. abst.)

2259. Margolis, L. 1958. THE OCCURRENCE OF JUVENILE CORYNOSOMA (ACANTHOCEPHALA) IN PACIFIC SALMON (ONCORHYNCHUS SPP.) Journal of the Fisheries Research Board of Canada, Vol. 15, No. 5, pp. 983-990.

Of 2406 Oncorhynchus nerka and O. gorbuscha collected in 1955 and 1956 from many localities throughout their range in the North Pacific and adjacent seas, 1.79% were infected with juvenile Acanthocephala of the genus Corynosoma. In O. nerka the genus was represented by C. strumosum, C. villosum, C. semerme and C. hadweni, all of which use Pinnipedia as the normal definitive hosts. C. strumosum and C. villosum were found in O. gorbuscha. Apparently there are no previous reports of the genus Corynosoma in Oncorhynchus, nor of C. semerme and C. hadweni in any intermediate host in the North Pacific region. O. nerka is the first recorded intermediate host of C. villosum. Data on incidence and intensity of infection of the two hosts by each of the species and the locality and date of catch of the infected salmon are tabulated. Brief descriptions of the four species, based on the collected specimens, are given. (Auth. abst.)

2260. Ricker, W. E. 1958. MAXIMUM SUSTAINED YIELDS FROM FLUCTUATING ENVIRONMENTS AND MIXED STOCKS. Journal of the Fisheries Research Board of Canada. Vol. 15, No. 5, pp. 991-1006.

Using numerical models, effects of environmental variability upon yield were tested for six single-age fish stocks characterized by different kinds and degrees of density-dependent reproduction potential. The two levels of variability examined had extremes of yield standing in the ratios 7:1 and 18:1, respectively. Close regulation of fishing to the optimum percentage for each year's stock improves the long-term average catch taken, the improvement being the greater, the more variable the environment. With the higher level of variability, improvement in average catch among five of the stocks ranged from 26% to 79% increase. However this increase in mean catch is achieved at the expense of increased variability in catch from year to year--in fact, for some kinds of stocks there must be complete cessation of fishing in some years in order to get the long-term maximum. The yield of stocks, in which reproduction per spawner declines at low levels of abundance, is particularly improved by a close adaptation of fishing effort to the supply of fish available.

When two or more populations of a species, characterized by different reproduction potentials, are fished in common, total potential catch is less than when each can be fished separately at its optimum level. If a common fishery cannot be avoided, the achievement of maximum average yield may find one of two originally-equal stocks as abundant or even more abundant than before the fishery began, while the other may persist only at a low level or even be exterminated completely. (Auth. abst.)

2261. Shepard, M. P., and F. C. Withler. 1958. SPAWNING STOCK SIZE AND RESULTANT PRODUCTION FOR SKEENA SOCKEYE. Journal of the Fisheries Research Board of Canada, Vol. 15, No. 5, pp. 1007-1025.

For age 4 and 5 Skeena sockeye, plots of total production of adults from individual brood years against number of parent spawners gave a reproduction curve with an almost linear ascending limb and a very precipitous descending limb. Maximum reproduction (2.4 million sockeye) was achieved at spawning levels of slightly over 0.9 million; the maximum sustained yield (1.4 million) was provided by spawnings of 0.9 million. The stock is very sensitive both to small changes in fishing intensity, and to random variations in survival caused by density-independent environmental fluctuations. Therefore the attainment of high sustained yields by application of a constant optimum exploitation rate is not practical. Regulation to provide the optimum number of spawners each year would more likely provide the highest average yield. Observed fluctuations in commercial catches over the past 50-odd years can be accounted for by changes in annual rates of exploitation. Still higher yields might be attained if individual components of the composite stock studied could be managed separately. (Auths. abst.)

2262. Terhune, L. D. B. 1958. THE MARK VI GROUNDWATER STANDPIPE FOR MEASURING SEEPAGE THROUGH SALMON SPAWNING GRAVEL. Journal of the Fisheries Research Board of Canada. Vol. 15, No. 5, pp. 1027-1063.

The groundwater standpipe is a length of pipe, pointed at one end, and has a number of perforations near the point. This is driven into the gravel, where the groundwater flows through it. The permeability of the gravel is measured by lowering the level of water inside the standpipe, one inch below the level outside, and measuring the rate of inflow. The apparent velocity through the gravel is measured in terms of the rate of dilution of a colour solution in the standpipe. A colour is introduced, and its rate of dilution determined from successive small samples taken at suitable intervals of time.

Velocity data from the earlier models were erratic and the permeability calibration did not include the range encountered in nature. In the Mark VI model, the standpipe is open during measurements of permeability. During measurement of groundwater velocity, the colour dilution chamber is completely sealed, colour is introduced and withdrawn through a sphincter valve with a hypodermic syringe. The solution is stirred during the period of dilution.

The criteria of the measurements have been reconsidered. The standpipe, auxiliary equipment, and procedure have been redesigned, and the new model recalibrated. All this resulted in some loss of simplicity, but the data are consistent and accurate within 5%. The equipment is still simple and rugged enough for field examination of salmon spawning redds.

Complete details of design, construction, and procedure, for use in salmon spawning gravels are given in Appendices. (Auth. abst.)

2263. Waldichuk, Michael. 1958. DRIFT BOTTLE OBSERVATIONS IN THE STRAIT OF GEORGIA. Journal of the Fisheries Research Board of Canada. Vol. 15, No. 5, pp. 1065-1102.

Drift bottle observations were carried out in the Strait of Georgia during the summers of 1926-1929. A total of 1,636 bottles was released of which 672 were recovered, giving an over-all return of 41%.

No consistent pattern of drift in the strait as a whole could be clearly drawn from the recoveries. Some consistency of circulation in local areas can be inferred from the net drift of bottles.

Winds dominated drift bottle movements in the open strait, where tidal currents are weak. A general northwestward drift was noted from releases along the eastern side of the strait and a southeastward drift along the western side. This suggests a large counterclockwise circulation of surface water over the whole strait. A smaller gyral circulating in the same direction is apparent in the southern strait, south of a line from Sand Heads to Active Pass.

A strong surface current is directed from the Fraser River estuary across the strait to the passes among the Gulf Islands. This seaward flow of fresh water is augmented by a strong seaward tidal current during large ebb tides.

Tidal currents are strong with definite periodicities in the channels bordering the strait. Current speeds of more than 26 cm./sec. (0.5 knot) were calculated from data on drift bottles whose drift was of brief duration. Average speed of drift was about 10 cm./sec. (0.2 knot). (Auth. abst.)

2264. Wickett, W. P. 1958. REVIEW OF CERTAIN ENVIRONMENTAL FACTORS AFFECTING THE PRODUCTION OF PINK AND CHUM SALMON. Journal of the Fisheries Research Board of Canada. Vol. 15, No. 5, pp. 1103-1126.

The relation between stock and numbers of spawners is obscured by annual environmental changes. Stream discharge at the time the spawners are migrating upstream, at the time when the eggs are in the early stage of incubation, and extreme discharge during the period eggs and alevins are in the gravel can impose an 8-fold variation in the stock resulting from a given number of spawners in one area. Ocean conditions soon after the fry enter the sea have been observed to increase or decrease survival by a factor of 3. The density of spawners that produces the greatest numbers of fry is related to the average permeability of the stream bottom. Preliminary data indicate that more spawners could be used to advantage in most areas of the coast. (Auth. abst.)

2265. Bailey, W. B. 1958. ON THE DOMINANT FLOW IN THE STRAIT OF BELLE ISLE. Journal of the Fisheries Research Board of Canada. Vol. 15, No. 6, pp. 1163-1174.

In addition to the usual tidal currents in the Strait

of Belle Isle, there is, at times, a tendency for the current to set in one direction more than in the other. This over-balance of water movement in one direction is termed the element of dominant flow. The possible causes of this flow are attributed to meteorological factors and to others effecting long-period fluctuations in sea level.

Very few extended oceanographic observations have been available to illustrate this phenomenon on a grand scale, particularly for a westerly flow. Observations taken in September 1955 illustrate a dominant westerly flow in considerable detail. This dominant flow was associated with the passage of an intense low pressure area (Hurricane Ione) from the Gulf of St. Lawrence to the Labrador Sea between September 21-23, 1955. (Auth. abst.)

2266. Huntsman, A. G. 1958. SHUBENACADIE SALMON. Journal of the Fisheries Research Board of Canada. Vol. 15, No. 6, pp. 1213-1218.

Salmon from the fishery in the brackish outflow of the Shubenacadie River through its estuary and Cobequid Bay consist mainly of 3-year-old grilse that are much larger than comparable fish taken in Grand Lake at the head of the River, and somewhat larger than comparable fish taken in Minas Channel through which these waters are connected with the Bay of Fundy. These salmon are found to be peculiar also in age composition and thus to form a separate population. That they are large for their age is attributed to exceptionally good estuarial conditions for production of zooplankton and for feeding.

With low rainfall these fish are caught mainly far in the outflow and with high rainfall far out. Their numbers fluctuate greatly for unknown reasons except that utter failure of the grilse in 1951 has been found related to lack of rain when they should have been spawned. (Auth. abst.)

2267. Jermolajev, E. G. (née Kossiackine). 1958. ZOOPLANKTON OF THE INNER BAY OF FUNDY. Journal of the Fisheries Research Board of Canada, Vol. 15, No. 6, pp. 1219-1228.

The inner Bay of Fundy and Minas Channel are practically devoid of locally produced zooplankton. The few plankters present are either estuarine species from Minas Basin and Chignecto Bay or immigrants from the Gulf of Maine. The former (Acartia tonsa, Eurytemora herdmani, Centropages hamatus, Pseudodiaptomus coronatus and Canuella canadensis) are abundant inland with shallowing and heavy river discharge. The latter (Calanus finmarchicus, Sagitta elegans, Pseudocalanus minutus, Oithona similis and Parafavella gigantea) all show a similar distribution, being abundant in the mouth of the Bay, but declining greatly going inward. Also, Calanus specimens from the inner Bay have little or no fat, which indicates a lack of food there.

The extreme paucity of all zooplankton in Minas Channel is apparently caused by heavy and deep turbulence, which prevents development of phytoplankton on which the animals depend for food. (Auth. abst.)

2268. Lauzier, L. M. and R. W. Trites. 1958. THE DEEP WATERS IN THE LAURENTIAN CHANNEL. Journal of the Fisheries Research Board of Canada, Vol. 15, No. 6, pp. 1247-1257.

Data pertinent to the deep warm waters of a three-layer system in the Cabot Strait area of the Laurentian Channel have been collected since 1915. Typical temperature-depth curves indicate that the temperature of the deep layer reaches a maximum at about 250 m. which shows little or no seasonal variations. Observations show warming of the deep layer from the 1920's to the 1950's. This upward trend of temperatures is accompanied by an increase in volume of the deep layer. The deep layer consists of a mixture of "Labrador" and "Slope" waters in which the mixing ratio of the components remains fairly constant from year to year. Fluctuations in temperature of "Labrador" water are reflected by a corresponding change in temperature of the deep layer in the Laurentian Channel. The vertical structure of the waters in the lower Laurentian Channel and the transport of the waters in Cabot Strait suggest that in the deep layers, there is a continuing supply of oceanic waters to the Gulf of St. Lawrence. (Auths. abst.)

2269. McKenzie, R. A. 1958. AGE AND GROWTH OF SMELT, OSMERUS MORDAX (MITCHILL), OF THE MIRAMICHI RIVER, NEW BRUNSWICK. Journal of the Fisheries Research Board of Canada. Vol. 15, No. 6, pp. 1313-1327.

Smelt develop scales at 20 to 25 mm. length. The circuli or ridges on them grow from the anterior and posterior to meet laterally. The posterior free part of the smelt scale is larger than the anterior and is used in age determinations. When scale growth ceases during winter a "scar" or "line" forms just outside the incomplete ridges around the edge of the scale. Hatching occurs in early summer. Scales generally develop 2 to 3 months later. Some scales are only clear platelets at the end of the first growing season. The "line" which forms around the margin of each scale is the only evidence of the first annual growth check. A positive correlation exists between number of ridges formed on the scales during the first year and lengths of fish within a year-class. There is no significant difference in weight of the sexes at the same length during the fishery, though females do have a faster growth rate than males, accelerating as they grow older. In the fishery and at spawning the average size of different ages declines as the season progresses. Smelt in the Miramichi generally mature at the end of their second year when 105 to 120 mm. long. They are caught in the commercial fishery in quantity for the first time during the winter preceding the end of their second year when they usually comprise about two thirds of the catch. Early hatching is correlated with greater growth in the first year and this greater size persists as smelt grow older. (Auth. abst.)

2270. McKenzie, R. A., and B. E. Skud. 1958. HERRING MIGRATIONS IN THE PASSAMAQUODDY REGION. Journal of the Fisheries Research Board

of Canada, Vol. 15, No. 6, pp. 1329-1343.

From June 20 to November 21, 1957, 37,495 herring were tagged in the southern part of the Bay of Fundy and Gulf of Maine. These fish were immature and ranged in total length from 14.2 to 18.7 cm. and in age from 1 to 3 years. Recovery of 792 (2.1%) tagged individuals indicated that the herring moved in and out of Passamaquoddy Bay throughout the summer and early autumn. No interchange of herring took place between Passamaquoddy Bay and the coast of Maine or Nova Scotia. Herring moved into Passamaquoddy from as far south as Grand Manan Island and as far east as Point Lepreau. The greatest straight-line distance moved was 55 miles, the mean time before recapture was 12 days, and the longest time 82 days. (Auths. abst.)

2271. Smith, M. W., and J. W. Saunders. 1958. MOVEMENTS OF BROOK TROUT, SALVELINUS FONTINALIS (MITCHILL), BETWEEN AND WITHIN FRESH AND SALT WATER. Journal of the Fisheries Research Board of Canada, Vol. 15, No. 6, pp. 1403-1449.

Major movements of trout into Ellerslie Brook, Prince Edward Island, were in April, June-July, and November; and out in May and October to early January. Some movements were preponderantly in one direction; others involved trout making simultaneous movements up and down stream. Mean length of trout in movements was 16.8 cm., predominantly age II. Trout were short-lived and few survived to make repeated movements. About 50% of trout making return movements did so within a month. Percentage of Ellerslie-reared trout which ran to salt water varied from 12 to 35 over a 6-year period. There was inconclusive evidence of a heritable propensity to sea-running. After descending into the estuary, few trout left for open coastal waters. Short-distance movements resulted in population shifts in the brook in summer which were not detected in traps at mouth of stream.

Movements of trout between fresh and salt water were very closely associated with rise and fall of the water level in the brook, but not with height of water. Movements in spring and early summer were into preferred temperature. Although marked changes in water level occurred, few trout moved in winter after becoming acclimated to a water temperature of 0°C. or in summer when brook was at temperature of final preferenda. Continuance of movement for some time after 0°C. was reached seemed related to slow rate of acclimation. Movements were both random and directed. For most movements trout appeared conditioned by temperature and stimulated by changing water levels. Trout moved largely at night. Other influencing factors were living space, maturation and spawning. Turbidity, salinity, tides, and handling were without apparent effects. (Auths. abst.)

2272. Beak, T. W. 1958. TOLERATION OF FISH TO TOXIC POLLUTION. Journal of the Fisheries Research Board of Canada, Vol. 15, No. 4, pp. 559-572.

The field biologist who is faced with the problem of determining whether a particular toxic pollution will be harmful to a fishery suffers from a severe lack of reliable data. Certain tests, such as TL_m estimations, or those of Herbert or Alderice and Brett, are available, but these will not give him a complete answer. There remains a whole group of unknown, or but partly known, sub-lethal stresses for which he has no means of direct measurement.

Current research is moving towards reduction of the unknown factors in this field, but there is still much to be done. In the meantime the best he can do is use the existing methods to obtain the best available estimates and test these estimates by means of biological surveys carried out in the field. Ultimately the test of whether a fish tolerates a particular toxic pollution is whether it continues to prosper in an environment in which it previously prospered and into which the pollution has been introduced. The work of the past seven years has, however, enabled him to make better estimates of the likelihood of it prospering than was formerly possible. (Auth. summ.)

2273. Black, Edgar C. 1958. HYPERACTIVITY AS A LETHAL FACTOR IN FISH. Journal of the Fisheries Research Board of Canada, Vol. 15, No. 4, pp. 573-586.

Death occurs in fishes under certain circumstances following severe muscular activity. The conditions described include struggling in a live box, responding to vigorous chasing, swimming through swift passages of water, and struggling on a trolling line. Death has been observed under these conditions both for fishes such as salmon, striped bass and shad in fresh water, and fish such as two-year-old sockeye salmon, nearly mature chinook salmon, and codfish and flatfish in sea water.

The precise cause of death is not yet known. However, it is likely that the severe acid-base disturbance following the large accumulation of lactic acid may be the principal cause of death. In any case the acid concentration is sufficient to reduce the oxygen combining power of the blood, reduce the alkali reserve or carbon dioxide combining capacity of the blood and alter the shape and probably volume of the red blood cells. There appears to be a marked reduction in the ability of the heart to pump blood following severe exercise. The ability of the fish to maintain an upright position and the respiration are commonly disturbed immediately prior to death.

Severe muscular activity rapidly reduces the maximum swimming capacity of trout. Other changes in behaviour were noted, namely the failure of fish to swim in a school shortly after vigorous activity; and a change from evading the chaser by rapid swimming to a pattern of seeking out dark corners to avoid capture.

The importance of severe muscular activity to the study of biology and especially of the physiology of fishes is clear. Both the oxygen and carbon dioxide carrying capacity of the blood must be profoundly altered by accumulations of fatigue products. The question of oxygen debt must also be considered

following a history of activity in fishes.

Hyperactivity as a lethal factor in fishes is of very great significance in problems of fisheries management. The consequence of severe muscular activity is important in every aspect of handling of fishes, for example, live transport of fishes, tagging, construction of fishways, etc. (Auth. summ.)

2274. Brett, J. R., M. Hollands and D. F. Alderdice. 1958. THE EFFECT OF TEMPERATURE ON THE CRUISING SPEED OF YOUNG SOCKEYE AND COHO SALMON. Journal of the Fisheries Research Board of Canada, Vol. 15, No. 4, pp. 587-605.

The cruising speeds of underyearling and yearling sockeye and coho salmon were determined in a rotating annular trough, for acclimation temperatures ranging from 1° to 24° C. Variation in swimming speed characterized the first 40 to 50 minutes; subsequently a relatively steady state was obtained.

Optimum cruising speeds occurred at 15° C. for sockeye and 20° C. for coho. Maximum sustained levels fell mainly between 1.0 and 1.5 ft. per second (30 and 45 cm. per sec.).

Exercised young coho showed improved performance over those raised in standard hatchery troughs.

The significance of the relative swimming capacities of the two species, and the effect of temperature, is discussed in relation to their ecology. (Auths. abst.)

2275. Ferguson, R. G. 1958. THE PREFERRED TEMPERATURE OF FISH AND THEIR MIDSUMMER DISTRIBUTION IN TEMPERATE LAKES AND STREAMS. Journal of the Fisheries Research Board of Canada, Vol. 15, No. 4, pp. 607-624.

Laboratory studies of preferred temperature with yellow perch (Perca flavescens) are compared with results from 21 other species. These show that temperature, if acting alone, can determine the distribution of fish in laboratory apparatus. Factors such as light, conditioned responses related to feeding routines, and social behaviour can interfere with the expression of the response to temperature. Subdued lighting conditions were necessary in the experiments with Oncorhynchus, Salvelinus and Coregonus, whereas full daylight was required in experiments with Perca flavescens.

The level of thermal acclimation influences the range of temperature preferred. In general the preferred temperature is considerably higher than the acclimation temperature at low thermal acclimations, but this difference decreases up to the final preferendum, where both coincide. The final preferendum and the relation between acclimation and preferred temperature is characteristic for the species. The shape of the resulting curve may have some value in interpreting observations of fish mortalities and distribution in nature. The final preferendum of the yellow perch from the present work was 24.2°C., from other work using older fish it was 21.0°C.

Summer field observations of yellow perch in Lake Nipissing, Costello Lake and Opeongo Lake, in Ontario, showed average thermal distribution of 19.7°C., 21.0°C. and 21.2°C. respectively. This agrees well with 20.8°C. observed for four Wisconsin lakes. Oxygen depletion reported for Tennessee Valley reservoirs, distribution of primary prey species of lake trout in New York waters and other factors, have been shown to modify the thermal distribution in nature. Differential sex response to temperature may be important in the perch. Field observations of thermal distributions for other species are also presented.

A comparison of the laboratory and field data shows good agreement with fish having colder final preferenda: Salvelinus fontinalis, Salvelinus namaycush, Salvelinus hybrid and Coregonus clupeaformis. Fish with warmer final preferenda, such as Micropterus salmoides, Micropterus dolomieu and Lota lota lacustris, showed higher temperatures in the laboratory than was shown by field observations. Young Perca flavescens showed similar results, but experiments with older perch showed excellent agreement between laboratory results and field observations. The lack of agreement between laboratory results and field observations is attributed to age differences; laboratory experiments being performed with young fish and field observations being made on older fish. (Auth. abst.)

2276. Paloheimo, J. E. 1958. A METHOD OF ESTIMATING NATURAL AND FISHING MORTALITIES. Journal of the Fisheries Research Board of Canada. Vol. 15, No. 4, pp. 749-758.

A simple method of estimating instantaneous natural and fishing mortality rates is given. It uses the maximum of the available information. The method requires data on numbers caught by age-classes, and data on (effective) effort for a series of years. For each year-class is calculated the weighted sum of catches from all age-groups from a given age on, and these sums are used as estimates of year-class strengths. The weighting factors depend on the instantaneous fishing and natural mortality rates; the best values of mortality rates are arrived at by iteration. When statistics are not complete a correction factor can be applied. This method is compared with Fry's "virtual" population size estimates; in both cases the basic statistics are catches. We have, however, introduced correction factors to allow for varying fishing intensities and incomplete statistics at older ages. (Auth. abst.)

2277. Wright, John C. 1958. THE LIMNOLOGY OF CANYON FERRY RESERVOIR. I. THE PHYTOPLANKTON-ZOOPLANKTON RELATIONSHIPS IN THE EUPHOTIC ZONE DURING SEPTEMBER AND OCTOBER, 1956. Limnology and Oceanography. Vol. 3, No. 2, pp. 150-159.

Phytoplankton and zooplankton standing crop, gross and net primary production were measured. From these data the daily rate of loss of phytoplankton from the euphotic zone was calculated. The phytoplankton

loss correlated well with zooplankton during September and with vertical water movement during October. A grazing coefficient was calculated (G=1.064 L water/mg dry wt. zooplankton/day). By use of this coefficient the loss of phytoplankton by zooplankton grazing was calculated for the period of study and averaged 0.255 mg glucose/L/day. Zooplankton assimilation averaged 0.216 mg glucose/L/day, indicating a digestive efficiency of 85%. Gross and net primary production from September 6 to October 17 amounted to 137.2 and 114.0 g glucose/m^2, respectively. Zooplankton assimilation was estimated to be 85% of net primary production. The ratio of zooplankton net production to zooplankton assimilation was 10.5%. (Auth. abst.)

2278. Reid, Joseph L., Jr. 1958. A COMPARISON OF DROGUE AND GEK MEASUREMENTS IN DEEP WATER. Limnology and Oceanography, Vol. 3, No. 2, pp. 160-165

Two series of current measurements made with GEK and drogues are shown to agree closely, not only in the averaged results of three days' data, but in short-period variations about the mean. The variations measured are probably too large to be the ordinary tide, and the possibility of their being the orbital velocities of internal waves is discussed. (Auth. abst.)

2279. Pierce, E. Lowe. 1958. THE CHAETOGNATHA OF THE INSHORE WATERS OF NORTH CAROLINA. Limnology and Oceanography, Vol. 3, No. 2, pp. 166-170.

Plankton samples were taken along the coast and in the sounds of North Carolina to determine the inshore distribution of the Chaetognatha. Five species were found within ten miles of the coast. The large northern sounds with water of reduced salinity do not appear to support an appreciable chaetognath population. Sagitta hispida and S. tenuis, the two characteristic inshore species, were common in the small bays and sounds south of Pamlico. Cape Hatteras with the colder Virginian water to the north appears to be a barrier to the northward occurrence of S. hispida. A more concentrated population of chaetognaths was found inshore than collections made a few years earlier indicated for the offshore waters. The same five species were also found along the west coast of Florida in an earlier study. (Auth. abst.)

2280. Patterson, Ashton M. 1958. TURBULENCE SPECTRUM STUDIES IN THE SEA WITH HOT WIRES. Limnology and Oceanography, Vol. 3, No. 2, pp. 171-180

Turbulence measurements of scales as small as two inches have been made in the ocean with hot-wire equipment which was especially designed for use in sea water. Observations have been made of the variation of the turbulence spectrum over a tidal cycle in the Strait of Juan de Fuca and of the influence of an underwater obstacle in altering the spectral distribution. A preliminary experiment has been carried out to correlate velocity and pressure fluctuations due to turbulence in the ocean. From the work done to date the specifications for a hot-wire instrument for use in the sea can be outlined. A review of several types of turbulence measuring instruments that have been used in water is included. (Auth. abst.)

2281. Mackereth, F. J. H. 1958. A PORTABLE CORE SAMPLER FOR LAKE DEPOSITS. Limnology and Oceanography. Vol. 3, No. 2, pp. 181-191.

A pneumatically operated core sampler is described which is easily portable and may be used by two men from a rowing boat. The apparatus takes an undisturbed sediment core 6 m long and is substantially independent of water depth up to a limit of some 250 m. The hydrostatic pressure operating on a cylindrical anchor chamber embedded in the sediment is used to hold the apparatus in contact with the bottom while the coring tube is driven downwards by compressed air. On completion of the coring operation, the anchor chamber is automatically filled with air, the coring tube is extracted from the sediment, and the apparatus brought to the water surface by the buoyancy lift. The use of heavy weights and the associated lifting tackle is therefore avoided. (Auth. abst.)

2282. Frey, D. G., and J. B. Stahl. 1958. MEASUREMENTS OF PRIMARY PRODUCTION ON SOUTHAMPTON ISLAND IN THE CANADIAN ARTIC. Limnology and Oceanography. Vol. 3, No. 2, pp. 215-221.

Primary production in two lakes of contrasting morphometry in the Canadian Artic was estimated independently from the differences in oxygen, pH, and carbon uptake between light and dark bottles. The estimates were in general agreement. Together with production estimates from two other high latitude lakes reported in the literature the data show that the morphometry of the lake basins exerts a considerable control over rate of production, with the shallower lakes having a higher intensity of production (g C/m^3/day) than the deeper lakes. The available data also suggest strongly that the rate of production is generally low in the Artic, and that the amount of production accomplished by the more productive lakes is roughly the same order of magnitude as that of the least productive temperate lakes reported in the literature. (Auths. abst.)

2283. Prowse, G. A., and J. F. Talling. 1958. THE SEASONAL GROWTH AND SUCCESSION OF PLANKTON ALGAE IN THE WHITE NILE. Limnology and Oceanography. Vol. 3, No. 2, pp. 222-238.

A description is given of the seasonal growth and succession, over five years, of planktonic algae in a region of the White Nile affected by a reservoir. Dense populations develop during the period of water storage, and are dominated by the diatom Melosira granulata and the bluegreen alga Anabaena flos aquae var. intermedia f. spiroides. The sequence of their development is related to their abundance in the river water entering the reservoir basin. Reactions of algal development upon water characteristics

include a considerable increase in pH and depletion of nitrate, phosphate, and probably silicon concentrations. Deficiency of inorganic nitrogen probably limits the maximum densities of Melosira. Maximum algal densities were in the range 20 ±8 mm^3 cell volume (or approximately mg dry weight) per L, and were associated with high rates of photosynthetic production, estimated in 1953 as approximately 2.2 g carbon/m^2/day. The variation of photosynthetic rates with depth and population density is described for the decline of the 1953 population maximum. (Auths. abst.)

2284. Allen, Donald M., and Anthony Inglis. 1958. A PUSHNET FOR QUANTITATIVE SAMPLING OF SHRIMP IN SHALLOW ESTUARIES. Limnology and Oceanography. Vol. 3, No. 2, pp. 239-241.

This net was designed to yield quantitative samples while being operated by one man in stiff, rooted vegatation in depths of from 3 to 18 inches. Construction details are given.

2285. Ricker, W. E. 1958. SOME PRINCIPLES INVOLVED IN REGULATION OF FISHERIES BY QUOTA. The Canadian Fish Culturist, Issue Twenty-two, pp. 1-6.

A general discussion of objectives and characteristics of fishery regulation by quotas, of characteristics of catch quotas, and of the effects of quota regulation on fishermen and the industry is presented.

2286. Hart, J. L. 1958. SOME SOCIOLOGICAL EFFECTS OF QUOTA CONTROL OF FISHERIES. The Canadian Fish Culturist, Issue Twenty-two, pp. 17-19.

The main effect seems to be the discouragement of specialized full time fishermen or of those who specialize in one fishery. Another related effect is the encouragement of many to participate in harvesting the resource due to very productive fishing at the beginning of the quota period, thereby reducing the potential of professional fishermen. Similar features are, however, also inherent in other management devices.

2287. MacKenzie, W. C. 1958. SOME ECONOMIC ASPECTS OF CONTROL BY QUOTA. The Canadian Fish Culturist, Issue Twenty-two, pp. 21-24.

Substantial diseconomies, both internal and external, for the fishing industry which are involved in quota control are described. A solution is offered. This, however, if fraught with formidable implementation obstacles, the most significant being concerned with international exploitation of a resource in which several optimum levels of fishing intensity would exist.

2288. Anderson, William W., and Jack W. Gehringer. 1958. PHYSICAL OCEANOGRAPHIC, BIOLOGICAL, AND CHEMICAL DATA --SOUTH ATLANTIC COAST OF THE UNITED STATES. M/V THEODORE N. GILL CRUISE 6., U. S. Fish and Wildlife Service, Department of Interior, Special Scientific Report--Fisheries No. 265. 99 pgs.

This is the sixth in a series of reports presenting basic data from cruises of the Theodore N. Gill in waters off the South Atlantic coast of the United States. Background of the investigations; objectives; procedures on station; and chemical, biological, and oceanographic methods and procedures were presented in the report for Cruise 1 (Anderson, Gehringer, and Cohen, 1956). Biological methods and procedures were the same as those modified on Cruise 3 (Anderson and Gehringer, 1957).

2289. Lennon, Robert E., and Phillip S. Parker. 1958. APPLICATIONS OF SALT IN ELECTROFISHING. U. S. Fish and Wildlife Service, Department of Interior, Special Scientific Report--Fisheries No. 280. 11 pgs.

The use of cattle blocks of salt is an effective and economical means of reducing high resistivities and improving electrofishing in large and small, high and low, cold and warm streams in the southern Appalachian Mountains. Electrofishing trials were conducted in salted and salt-free sections of high resistivity streams. Using salt improved the effective range of the electrode system. A greater percentage of available fish was taken on initial passes through test sections; larger numbers of fish were taken per section due to the extended effective range of the electrodes; and the fish were more thoroughly stunned and easier to net. The rate of mortality among trout taken in salted section was less than 1 percent greater than among fish collected in salt-free sections. The high yield of fish obtained provides more accurate population estimates. (Auths. abst.)

2290. Kalleberg, Harry. 1958. OBSERVATIONS IN A STREAM TANK OF TERRITORIALITY AND COMPETITION IN JUVENILE SALMON AND TROUT (SALMO SALAR L. AND S. TRUTTA L.) Report No. 39 from the Institute of Freshwater Research. Sweden. pp. 55-98.

This dissertation of territorial behavior in juvenile salmon and trout is based on observations distributed over the years 1954-57 while other studies were being conducted. The structure of the territory, the activity of the fish within the territory, the development of aggressiveness and territoriality in the individual, the territoriality-schooling transformation, and competition are covered.

Each individual possesses within its territory one strongly dominating, strictly localized station. Localization of stations is remarkably constant; positions of an individual could be indicated within a few millimeters following any foray. From this station, a territory of rather diffuse boundaries and somewhat irregular shape is defended. It is a pronounced bottom territory, extending very little in a verticle direction. Size of territory is correlated, positively, in a high degree with size of fish and visual isolation in the biotope, and negatively, with stream velocity.

Attempts to drive individuals from their territories, e.g. with a stick, were difficult and generally unsuccessful. Most of those which were successfully displaced reoccuppied their original territories with

varying rapidity, from less than a minute to 2 days.

The territories of juvenile trout and salmon are feeding territories. Under normal conditions the feeding range in a horizontal direction corresponds roughly to the size of the territory, whereas in verticle direction the excursions for food are extended beyond the territory. Length and frequency of feeding excursions increased in afternoon and twilight hours and, in winter, diminished with darkness to complete cessation; a new maximum was reached in the early morning hours. During summer, at this latitude of about 63°N, feeding continued throughout the night.

"Agnostic behavior", a collective designation of attack and flight reactions, is similar in major components in both species. Both exhibit a frontal and lateral threat display. Fights with actual physical contact occur in all stages of both species, though more pronounced in trout.

The aggressive behavior of salmon and trout develops early, with the beginning of feeding; more or less permanent stations soon develop. Threat signals, though developed at a very early age, play no important role in territorial fights of fish under 6-7 cms; visual signals are entirely subordinated to violent and protracted fights. There is an intimate connection between feeding and aggressiveness.

Reduction of current to near zero destroyed territorialism in fry which was replaced by verticle distribution and finally by schooling. During prolonged exposure to quiet water, 46 hours, the schooling tendency though still present started to dissolve. These results, together with studies of actively migrating smolts, leave the impression that two essentially opposite reactions between individuals is active. In fry and parr, territorial behavior and aggressiveness is dominant unless current velocity is near zero, in which event schooling and depression of aggressiveness is evident. In migrating smolt, schooling is dominant unless, by purely mechanical means, this behavior is prevented, in which event territorialism and aggressiveness assume dominance.

Severe overcrowding under rearing conditions also affected the rapidity with which salmon parr exhibited aggressiveness when provided more space; the longer they were subjected to overcrowding, the slower they were to exhibit aggressiveness. This is interpreted as a more or less severe blocking, due to the continuous contact for some time between individuals, of the nervous mechanisms lying behind aggressive behaviour.

Intraspecific competition for space within populations of juveniles depends upon the potential aggressiveness of individuals, i.e. size, and upon external factors, e.g. population density. An increase in size of individuals, not number is the usual intensifier of competition under normal conditions. Larger individuals are able to maintain and increase their superior standing, not through their greater potential aggressiveness of size alone but also through their stimulation of aggressiveness during their more frequent and intensive feeding. The territorial mosaic, because of growth of individuals and their potential aggressiveness, is changed from time to time by less strongly defended territories being relinquished, the displaced individuals being forced to assume less favorable stations from the viewpoint of food supply. Thus these slower-growing individuals, remaining for a greater length of time within the size group which runs the greatest risk of predation, are eliminated to a greater extent from the population. This increased risk of predation through retarded growth may be considered one of the most important consequences of intraspecific and interspecific competition.

Parr of salmon and brown trout, and likely brook and rainbow trout, possess an interspecifically understandable means of aggressive expression. All observations of aggressiveness between the salmon and brown trout point to clear dominance of the trout. Faster growth of trout can be expected to accentuate this dominance in the field.

2291. Fabricius, Eric, and Karl-Jacob Gustafson. 1958. SOME NEW OBSERVATIONS ON THE SPAWNING BEHAVIOUR OF THE PIKE, ESOX LUCIUS L. Report No. 39 from the Institute of Freshwater Research. Sweden. pp. 23-54.

Pike were observed in the field as well as in big aquaria, and movements were recorded on cine-film, partly in slow-motion.

Pike do not maintain spawning territories, but aggressive behaviour often occurs, when two individuals meet within the spawning grounds. In most cases this aggressiveness is limited to a threat posture. One case of real attack was observed in which a male bit an opponent in the flank.

Unripe females adopt the threat posture on the approach of a courting male, or "show" the male off by a sudden sideward bending of the head. Ripe females respond to the approach of a male by a slow forward swimming which initiates the courtship swimming of the couple. The males seem to prefer females which are larger than themselves. During the courtship the two fish slowly swim side by side, orientating themselves so that the eye region of the male is on a level with the eye region of the female. As a result of this orientation and of the different size of the partners, the genital opening of the male is during the courtship swimming usually slightly ahead of that of the female.

To the naked eye the spawning act appears as a sudden flap of the male against the female. Such spawning acts, repeated with short intervals, form long series, separated by periods of rest. During the spawning the pike swim forward, mostly parallel with, and close to the shore. Each female is usually followed by two or three males, but in small tanks one male becomes dominant, preventing the other males from taking part in the spawning. Some cases of homosexual behaviour have been observed in males. The act is described in detail.

Spawning is stimulated by high water temperature and by intense light. During the spawning the female, apparently mainly by a visual orientation, tries to reach and maintain a position above dense but comparatively short vegetation over which the eggs are sprinkled. This behaviour secures the deposition

of the eggs within the optimal habitat of the young, and the specialized movements of the spawning act contribute to the scattering of the eggs.

The absence in the pike of special spawning markings is a consequence of the lack of a territorial behaviour. This is missing, as it would counteract the spacing out of the eggs of each female. Another consequence of the lack of territorial behaviour is the high number of eggs in the female pike. As a rule females of territorial species have a comparatively small number of eggs.

Most of the movements included in the spawning act of the pike have probably been derived from swimming movements, but the repulsive head shaking of the female and the opening of the mouth of the male seem to originiate from displacement activities, or from incipient movements belonging to drives other than the sexual drive.

There is a discussion on some striking similarities between the spawning behaviour of the pike and that of the cyprinodontids, and particularly of Fundulus. (From Auth. summ.)

2292. Lindström, Par Thorolf. 1958. OBSERVATIONS SUR LES CYCLES ANNUELS DES PLANCTONS CRUSTACÉS, DUALISME DES POPULATIONS COPÉPODES --RÉPERCUSSION DES ANNÉES FROIDES --DIFFERENCES ENTRE DES LACS. Report No. 39 from the Institute of Freshwater Research. Sweden. pp. 99-145.

The annual cycles of the plankton Crustacea in some Jämtland lakes is investigated. New evidences in favour of the dualism theory are presented. This dualism implies that there are two fractions with different annual cycles in the Cyclops and Diaptomus populations. The dualism is far from equally evident in all lakes; there is no case of indisputable cohabitation of the two Diaptomus fractions in one lake.

The dualism is probably regenerated every winter. One fraction originates from copepodites IV and V -- old copepodites function as resting stage with the Copepods. The other fraction originates from resting eggs (Diaptomus) or as a spring pulse of nauplii and young copepodites (Cyclops). The origin of this nauplii production is not settled. Hypothetical mechanisms for the fusion of the fractions during the summer are discussed.

The comparison between lakes and between years are only supported by analysis of variance up to a certain point (Table 7), but the material contains other kinds of verifications (ontogenetical stage sequences, vertical tow net samples, repetition equivalent years). In Lake Håckren the speed of ontogenesis of Cyclops (fraction A) is greater than in Lake Ottsjön. In Lakes Håckren and Hottön the speed of ontogenesis of Diaptomus up to the adult stage is slower than in Lake Ottsjön. The differences cannot reasonably be directly depending on differences in temperature. Clear differences between maximal densities of plankton Crustacea cold and warm years could not be demonstrated. The paramount importance of the temperature factor is of course not denied, but an effect of the temperature factor could only be demonstrated as a retardment of the annual cycle in years with retarded breaking up of the ice and following cold summer.

There is a difference in the development of the cladocerean populations in different lakes: a maximum density in Lakes Håckren and Hottön is reached later in the summer than in Lake Ottsjön. The rapid development of two cladocerean populations in Lake Ottsjön and the rapid ontogenesis of the population of the third filter feeder (Diaptomus) in this unstratified lake and the slow ontogenesis of the particle seizer (Cyclops) indicate that food plays an important rôle in the processes discussed, filter feeder depending on the same food pulse. The unsettled assumption is advanced that the filter feeder Daphnia, Diaptomus and Bosmina compete for food.

The importance of the dualisme of the Copepod populations in diversified environment is discussed. (Auth. summ.)

2293. Nilsson, Nils-Arvid, 1958. ON THE FOOD COMPETITION BETWEEN TWO SPECIES OF COREGONUS IN A NORTH-SWEDISH LAKE. Report No. 39 from the Institute of Freshwater Research. Sweden. pp. 146-161.

The problem of the correlation between the number of gillrakers, the growth rate and the feeding habits of whitefish was studied on 1, 126 Coregonus pidschian and 430 Coregonus peled from Lake Vojmsjön in southern Swedish Lapland.

The feeding habits of the two species were found to vary with the size of the fish as well as seasonally and anually. It is suggested that a changeable food specialization, as is wellknown in salmonid fishes, is the fundament of the formation of food niches and may be valid also for other groups of animals. A regulation of the water-level is supposed to have altered and impoverished the prey fauna of the lake. Important differences were found in the feeding habits of the two species. The smaller species with numerous gillrakers (C. peled) had fed mainly on Entomostraca. The differences could be discerned also, if the fish were distributed into size-groups.

The present findings support SVÄRDSON's theory that the differences in growth rate between sympatric species of Coregonus are results of interspecific competition, implying a preference for food objects of different size, which affects the growth rate and the keeping of the species in different ecological niches. (Auth. summ.)

2294. Evans, Willis A., Orthello L. Wallis and Glenn D. Gallison. 1958. FISHES OF YOSEMITE. Yosemite Nature Notes, Vol. XXIII, No. 1, 30 pgs.

A description of each species with a key to species is presented. General management aspects including stocking, hatchery operations, and natural reproduction are discussed.

2295. Wharton, J. C. F. 1957 A PRELIMINARY REPORT ON NEW TECHNIQUES FOR THE ARTIFICIAL FERTILIZATION OF TROUT OVA. Snob's Creek Fisheries Research Station, Fisheries and Game Department, Victoria. Fisheries Contribution No. 6.

The artificial fertilization of trout ova is being studied with special reference to factors influencing the viability of gametes and to the optimum conditions for successful interaction of egg and sperm substances in the biochemical prelude to fertilization.

Over the last two spawning seasons, there has been a significant increase in the average percentage of ova fertilized and this improvement is attributed to use of the following new techniques, which are described: (i) a standard method for the determination of "ripeness" in female trout, (ii) a method and apparatus for taking eggs from a ripe female without affecting viability, involving the intraperitoneal injection of air, (iii) a method and apparatus for taking urine-free sperm from a ripe male trout, (iv) several specific modifications of the commonly used "dry" method of mixing gametes, and (v) an egg wash modified by the addition of 50-100 ppm calcium.

The claim is made that on this station use of procedures numbered 2 and 5 has almost eliminated the fungus control problem among pre-eyed ova, though delay in vitelline membrane breakdown of unfertilized eggs and of eggs which have ceased to develop.

A test is described which will usually indicate whether egg-viability has been affected by the process of stripping employed. (From Auth. abst.)

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